

**NOAA TECHNICAL MEMORANDUM  
NMFS-SEFC-248**

**BIOLOGICAL REVIEW OF THE 1989 TEXAS  
CLOSURE FOR THE SHRIMP FISHERY OFF  
TEXAS AND LOUISIANA**

BY

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FEBRUARY 1990

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# 1989 TEXAS CLOSURE REPORT

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## INTRODUCTION

The implementation of the Gulf of Mexico Shrimp Fishery Management Plan (FMP) in May 1981 permitted, for the first time, closure of the brown shrimp fishery from the coastline to 200 nautical miles off the Texas coast. The objectives of the Texas Closure Management Measure were to increase the yield of shrimp and to eliminate waste caused by discard of undersized shrimp in the exclusive economic zone (EEZ). According to the FMP, shrimp yield would be increased by protecting brown shrimp from fishing during the period when they were predominantly small and were rapidly growing. Discards would be reduced by eliminating the count restriction in order to allow all shrimp caught to be landed. For the past nine years the Gulf of Mexico Fishery Management Council (GMFMC) has agreed to continue this seasonal closure of the brown shrimp fishery off the Texas coast. The 1989 Texas closure was implemented from 1 June to 15 July 1989. The closure this season was from the coastline out to 200 nautical miles, which was similar to the first five years (1981-1985), but unlike the last three years (1986-1988) when the area closed was only from the coastline to 15 nautical miles off the Texas coast. The GMFMC initiated the 15 nautical mile closure in 1986 with the objective to protect small brown shrimp from capture, while still allowing the harvest of larger brown shrimp by fishermen in deeper waters. Yet enforcement proved to be very difficult for this type closure (Pruitt<sup>1</sup>), and the 200 mile closure was again utilized this season.

The Texas Parks and Wildlife Department sets the closing and opening dates for the fishery by assessing abundance, size, and growth rate of shrimp in Texas waters during April and June (Bryan, 1985). Prior to the FMP, Texas law closed the territorial sea from the shoreline out 9 nautical miles for 45 days during the mid-May to mid-July 1960-1980 period (60 days in 1976). Texas's objective was to insure that a substantial proportion ( $\geq 50\%$ ) of shrimp in Gulf waters had reached 65 tails/lb or 112 mm total length by season's opening. With the present FMP, the regulated portion of the EEZ is closed and opened in conjunction with the Texas territorial sea closure. The 1981-1986 closures all exceeded the historical 45-day closure by 5-10 days, while the last three closures (1987-1989) have been 45 days in length (Table 1).

The purposes of this report are to provide information to determine how well the objectives of the Texas Closure Regulation were achieved in 1988 and 1989 and to determine the differences between a 15 nautical mile closure and a 200 nautical mile closure. This report reviews and analyzes the characteristics of the Texas and Louisiana fisheries west of the Mississippi River and describes the catch, fishing effort, catch per unit of effort

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and recruitment to the offshore fishery from May 1988 to August 1989. The report deals only with the biological impacts of the closure and not the social and economic impacts experienced by the shrimp fishermen and the shrimp industry in general along the Gulf of Mexico coasts during the closure period.



## MATERIAL AND METHODS

### Fisheries Statistics

A collection of detailed catch statistics describing the U.S. Gulf of Mexico shrimp fishery (since 1956) is compiled by and available from the Southeast Fisheries Center (SEFC), Economics and Statistics Office (ESO). The procedures used to collect them are described by Klima (1980). The statistics consist of catch, recorded as pounds of shrimp (heads-off); fishing effort, recorded as either 24 hours of actual fishing time or numbers of trips; and size composition of catch, expressed in eight "count" or size categories representing number of shrimp tails per pound (<15, 15-20, 21-25, 26-30, 31-40, 41-50, 51-67, and >67). Starting in May 1982, ESO recorded pounds caught in size categories larger than 68 count as follows: 68-80, 81-100, 101-115 and >115 count.

To analyze the effects of the Texas closure, only commercial catch statistics from areas west of the Mississippi river (statistical subareas 13-21) were examined (Fig. 1). These data were used to compute catch per unit effort (CPUE) as pounds per 24 hours of fishing. The number of shrimp caught was estimated by multiplying the pounds caught in each size category by the mid-point of the size category, and in the case of <15 and >115 categories, by 15 and 116, respectively. Margo Hightower<sup>2</sup> and Lee Usie<sup>3</sup> provided specific information concerning the Texas and Louisiana inshore and offshore shrimp fisheries relative to fleet activities, changes in the fleet, number of trips, discards and specifics of catch and effort for the fishing area during 1988 and 1989.

### Statistical Treatment

Catch data frequently follow skewed distributions, show heteroscedasticity and have non-additive components. Transformations applied to the original data are often able to alleviate these problems and permit valid statistical analyses of the data employing t-tests and 2-way analysis of variance (ANOVA) (Sokal and Rohlf, 1969). Taylor's (1961) test analyzing relationships between means and variances was applied to the brown shrimp fishing data. The tests showed that catch data should be transformed to their logarithms, fishing effort data did not need to be transformed, and CPUE data should be transformed to their square roots. The analyses of these

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transformed data provided statistical support to what the untransformed data graphically depicted. The summaries are presented in this report using untransformed data.

The commercial catch data were grouped into biological years May-April since brown shrimp are recruited to the fishery in May of each year. The first and last biological years identified are May 1960-April 1961 (biological year 1960) and May 1988-April 1989 (biological year 1988).

Historical mean monthly catch, mean monthly fishing effort and mean monthly CPUE for the 1981-1985 period were compared with the May 1987-April 1989 monthly data via 2-way ANOVA using paired observations. Additional comparisons between the May-August monthly means of the fisheries data for statistical subareas 13-17 and 18-21 for the historical time series (1981-1985) were compared with the 1989 monthly data from May-August, using paired observations in a 2-way ANOVA and in t-tests. The shrimp size distributions for each month in 1988 and 1989 were compared with the historical data set. Unless otherwise stated, tests of significance were performed at the 95% level ( $P = 0.05$ ).

### Finfish By-Catch Analysis

Finfish by-catch from shrimp fishing activities off the Texas coast during the closure period were estimated with and without a closure of the EEZ. Historical finfish catch rates in June were obtained from Moore et al. (1970), while current finfish catch rates were obtained from Oregon II cruise data this past summer. In both cases, CPUE values (pounds per hour with a 40 foot trawl; overall total and for selected individual species) were determined for each statistical subarea and depth zone off the Texas coast. Catch rates for endangered species were multiplied by the average commercial shrimp effort expended in each statistical subarea and depth zone (5 fm intervals) during a 200 mile closure year (1981-1985) and during a 15 mile closure year (1986-1988). Only fish species that constituted 5% or more of the historical average catch by weight were selected for species composition comparisons. The percent of total for each species was multiplied by the mean total finfish CPUE to obtain an individual CPUE value for each species.



## RESULTS - BACKGROUND

### BIOLOGICAL YEAR COMPARISONS

#### Louisiana

##### Brown Shrimp Inshore Fishery

The inshore Louisiana brown shrimp fishery averaged 11.3 million pounds  $\pm$  3.8 million pounds standard deviation from 1960-1988 (Fig. 2). Peak production in Louisiana appears to be cyclic, with low production from 1960 to 1966 and above average production in all other years except 1973 to 1975 and 1979 to 1980. Historically, the Louisiana inshore fishery is active from May through August, with peak production in May and June.

During biological year 1988, the inshore Louisiana brown shrimp fishery had a total production of 14.1 million pounds, with 12.8 million pounds (91%) being taken in the May through June period. Thus, the inshore fishery experienced an above average year with regards to pounds caught, but it was not significantly above the historical average. Unlike the below average catch experienced during 1985, the 1988 production was comparable to other closure years.

During May-August 1989 production was 11.3 million pounds. Thus, catch during biological year 1989 will probably be only slightly above average.

##### Brown Shrimp Offshore Fishery

Annual production of brown shrimp from May to April in Louisiana offshore waters averaged 16.5 million pounds  $\pm$  8.3 million pounds standard deviation from 1960 to 1988. Annual yield was low in the early 1960's, increased to about 18 million pounds by 1967 and remained near this level through 1972 (Fig.3). Yield dropped to about 10 million pounds from 1973 through 1975. Thereafter, yield has been in most cases above the historical average of 16.4 million pounds, with yields around 30 million pounds in 1977, 1978, and 1986.

In biological year 1988, the Louisiana offshore brown shrimp fishery produced 20.2 million pounds of shrimp. This production level represents an above average catch when compared to the 29 year average (1960-1988), and is the ninth greatest catch recorded for this area (only exceeded by catch during 1976-1979, 1981, and 1984-1987).

The monthly pattern of shrimp production in Louisiana for biological years 1987, 1988 and the first four months of biological year 1989 was compared with the historical monthly average pattern (Fig. 4). Only March through April in biological



year 1987, and July 1988 exhibited catch values that were below average. Yet, of those that showed above average catch, none were significantly greater than their historical counterpart. Most fall and winter months (October -April) in 1987 and 1988 showed below average production for brown shrimp. This is easily observed when monthly comparisons were made between comparable months during the 1976-1989 period (Table 3). Peak production months were, as in the past, still May-August during the 1987-1989 period.

Biological year 1988 also exhibited an above average amount of effort (days fished). During the year about 49,000 days of fishing were recorded for the brown shrimp fishery in Louisiana. This is over twice the historical average of 23,900 days fished.

The monthly pattern of effort during biological year 1987, 1988 and the first 4 months of biological year 1989 was compared with the historical monthly average pattern (Fig. 5). All months except June 1988 and August 1989 had greater than average effort values, but only May 1987, July 1987, May 1988, August 1988 and May 1989 were significantly different from their historical counterparts. Effort values in May 1989 seemed extremely high and may be over estimated because of lower than average interview rates this year (see discussion later in this report). When monthly comparisons were made between comparable months and periods, effort values during the 28 month period under investigation (May 1987-August 1989) were either the highest or near the highest value observed during the 1976-1989 period (Table 3).

An average CPUE value of 412 pounds per day was observed in biological year 1988. This value is below the historical average for the offshore waters of Louisiana. Only June 1987, August 1987 and August 1989 had above average CPUE values (Fig 6.) Even with the average catch experienced during the 28 month period, the record levels of effort exerted in the offshore fishery produced poorer than average CPUE values for most months. The 1989 biological year thus far, appears to be above the historical average with respect to pounds caught, but fishermen will probably perceive it as a poor year because of low CPUE values and catches below those taken the last 4 years.

## Texas

### Brown Shrimp Inshore Fishery

Landings from the Texas inshore brown shrimp fishery have been increasing for the past several years. The average catch over the 29 year period (1960-1988) was 2.9 million pounds  $\pm$  2.4 million pounds standard deviation (Fig. 7). Average catch before 1979 was 1.4 million pounds  $\pm$  .7 million pounds, while after 1979 the average increased to 5.9 million pounds  $\pm$  1.5 million pounds.

The catch during biological year 1988 was 7.3 million pounds. This value is above the historical average, and represents the third largest value during the 29 year period.

The Texas inshore brown shrimp fishery takes place from late April through August. Peak production usually occurs in May and June. In biological year 1988, 72% of the total catch occurred during May and June. The month of July accounted for 14% of the total catch during 1988. This is the second year that July has been above the normal July catch level of <10% of the total.

During the May-August 1989 period, inshore production was 6.1 million pounds. This will probably make the inshore catch total for biological year 1989 above the historical average, but less than the amount taken during biological year 1988.

#### Brown Shrimp Offshore Fishery

The average annual brown shrimp yield from May to April in Texas offshore waters from 1960 to 1988 was 26.8 million pounds  $\pm 7.1$  million pounds standard deviation. Peak production occurred in 1967 and 1981 with a yield of 48 and 41 million pounds, respectively (Fig. 8). Annual production during biological year 1988 was only 24.2 million pounds. This production value was below average, but not significantly less than the historical mean. This level of catch was similar to the 24.2 million pounds taken during biological year 1984, and is the third smallest catch since the closure started in 1981.

The monthly pattern of shrimp production off Texas for biological year 1987, 1988 and the first four months of biological year 1989 was compared with historical monthly average pattern (Fig. 9). During biological years 1987 and 1988, both May and June had above average catches. These catch levels were similar to 1986 levels and occurred because the EEZ was opened to brown shrimp fishing beyond the 15 nautical mile line. During the 200 nautical mile 1989 closure, catch levels in May and June were similar to those found during other 200 mile closure years (Table 3). During biological years 1987 and 1988 after the closure was opened to fishing, above average to near average landings occurred during July, with below average catches from August through the early winter. During biological year 1989, in both July and August, fishermen experienced excellent catch levels, with reports that catch was above average also during the early winter months (October-November). During earlier 200 mile closure years (1981-1985), this early winter period has similarly had better than average landing (Table 3).

An annual effort value of about 49,800 fishing days was expended off the Texas coast during biological year 1988. Monthly effort values followed nearly the same trends as those shown for landings (Fig. 10). All months had greater than



average levels of effort, except August 1987, August 1988, September 1988 and July 1989. Only June 1987 had an effort value during this 28 month period that was significantly different from its historical average counterpart. These increased effort levels occurred because the closure was only out to 15 nautical miles offshore.

An average CPUE value of 486 pounds per day was occurred during biological year 1988. Most monthly averages were below historical averages (Fig. 11). Although none of the values during the 28 month period were significantly different from their historical counterparts, values during July and August 1989 were more similar to values found during other 200 mile closure years.

### Overview of 1988 Season

Biological year 1988 had slightly greater than average landings for brown shrimp for the entire area from west of the Mississippi River Delta to the Texas-Mexico border. Total brown shrimp production (inshore and offshore) in Louisiana was 34.3 million pounds (14.1 inshore and 20.2 offshore), while in Texas landings totaled 31.5 million pounds (7.3 inshore and 24.2 offshore). This produced a total of 65.8 million pounds (21.1 inshore and 44.7 offshore). This value represents a 10 million pound decrease from the 76.2 million pounds taken in the 1987 season, but is still greater than the 57.2 million pound historical average for the area (1960-1988).

### RECRUITMENT - FORECAST 1989

Data used in this forecast were provided by Louisiana Department of Wildlife and Fisheries, the Office of Economic and Statistics of the Southeast Fisheries Center and the Galveston Laboratory of the Southeast Fisheries Center. Collections of immigrating postlarval brown shrimp from the Galveston Bay jetty entrance yield the earliest indications of the future harvest. Juvenile brown shrimp stocks are later assessed using drop-sampler techniques in salt marsh habitats to check growth and abundance of the new-year-class shrimp. Finally, juvenile and subadult brown shrimp are monitored in the bait shrimp fishery during late April through mid-June to give a final account of stock strength before offshore migration.

Weather during the late winter and spring of 1989 was atypical and may have impacted the recruitment survival of brown shrimp this year. The first four months of 1989 were dry; rainfall was below normal for most of Texas and western Louisiana. During February through early April, the period when we expect maximum influx of brown shrimp post larvae into the bays - two severe cold fronts pushed through Texas and western Louisiana. The record low temperatures with accompanying low

tides hindered immigration and probably reduced survival of postlarvae. The low water also prevented the juvenile shrimp in the bays from utilizing marsh habitats and exposed them to additional predation. In early May and early June the weather changed radically with very heavy rainfall across much of Texas and western Louisiana causing flooding on many rivers. These high river flows and their consequent low salinities in the estuarine marsh nursery habitats of brown shrimp may have impacted survival of juvenile and subadult brown shrimp and pushed small brown shrimp out into the larger bays at a small size.

In Texas, all the indices pointed to a below average season (July 1989-June 1990) for the offshore waters of the state. Using a regression model based on bait shrimp catch per hour from 1960 through 1980, we estimated harvest off the Texas coast to be 23.1 million pounds. This value is 3.7 million pounds below the average catch of 26.8 million pounds experienced during the 1960 through 1988 period. This model has proved to be quite accurate since its creation (Table 3).

Another indicator of that annual production during the July-June period is the offshore catch in July and August in statistical subareas 18-21. Historically, the July-August brown shrimp catch averaged 47% of the total annual production from July to June. Since 1981, with the inception of the first closure, the July-August catch amounts to about 60% of the total annual production. The offshore catch in July-August 1989 from subareas 18-21 amounted to 16.3 million pounds or an estimated annual production of between 34.7 and 27.2 million pounds for the 47 and 60 percentages, respectively. These values are slightly higher than those predicted by the bait shrimp model this year.

Catch from Louisiana inshore and offshore fisheries in May were estimated to be 10.5 million pounds. Historically, the estimated May catch has usually been about 10-15% below what is actually taken from these waters during May, which has caused us to underestimate our forecast of the annual catch (Table 4). Our current information points to a 10% under estimation of the actual May catch. Therefore, we used the value of 11.7 million pounds (10.5 million pounds + 10%) for the May catch input into the regression model. We predicted a total inshore and offshore harvest of 43.7 million pounds for Louisiana west of the Mississippi River during the May 1989-April 1990 period, which is above the average of 27.8 million pounds for the area. This prediction is supported by Louisiana Wildlife and Fisheries data which estimated about 1.74 million acres of prime nursery for brown shrimp available this year. This Louisiana regression model has also proved to be accurate in its estimation of total annual catch.



## 1989 CLOSURE PERIOD

In 1989, the territorial sea of the state of Texas and the total EEZ adjacent to those territorial seas were closed to all shrimp fishing from June 1 to July 15, except for a daytime nearshore fishery directed at white shrimp. This section of the report represents an analysis of the brown shrimp statistics taken during the May-August period of 1989 from statistical subareas 13-21, inclusive.

### Louisiana

#### Brown Shrimp Inshore Fishery

The May through August 1989 catch in Louisiana for inshore waters amounted to 11.3 million pounds, with 91% of the total catch in May and June. This year's inshore production was higher than the 9.5 million pounds produced during the 1985 May through August period, but lower than all the other years since 1981. Inshore production was 12.4, 14.0, 14.9, 12.1 15.1 and 15.2 million pounds for 1987, 1986, 1984, 1983, 1982 and 1981, respectively.

In 1989, May inshore production was 4.5 million pounds with June production at 5.8 million pounds. Catch levels dropped quickly after June, with a July catch of 1.0 million pounds and an August catch of only 14 thousand pounds. Unlike the last few years, there was some early migration of small brown shrimp from inshore waters to offshore waters.

The proportion of the catch in the 116 and greater count size group this year was similar to last year and was greatly reduced compared to most other years. As in the past, large numbers of very small shrimp were caught in the May period, but unlike most other years, large numbers of medium sized shrimp were landed later in the season, thus reducing the overall percentage of small shrimp. This year only 43% of the shrimp landed were in the smallest size group (Table 5). The greater than 68 count size group accounted for 88% of the shrimp landed in the inshore fishery this year and not the usual 95% of the catch.

#### Brown Shrimp Offshore Fishery

In May 1989, the fishery off Louisiana produced only 6.7 million pounds of brown shrimp, with over 17,600 days of fishing effort, for an average CPUE value of only 381 pounds per day. The effort value represents the highest level achieved off Louisiana since at least 1974, while the catch is the third highest experienced (Table 3). The CPUE value is one of the worst ever calculated since at least 1975 (Table 3). Similar to most years, but unlike 1987, the majority of the catch (94%) and

effort (93%) occurred in the shallow waters of statistical subareas 13-15 (Fig. 12 a and b). Very little catch or effort was experienced in either statistical subarea 16 or 17 during May. CPUE values averaged around 400 pounds per day in all areas except subarea 16 which had only 300 pounds per day. All CPUE values were greater than those experienced last year (Nance, et al., 1989).

In June, the fishery off Louisiana produced 6.2 million pounds of brown shrimp with a fishing effort of over 10,900 days. This June effort was the second greatest ever experienced since 1975, (only below the 1987 value), with the catch level also being one of the greatest experienced (Table 3). The record amount of effort exerted with above average catches, created an average CPUE value of 571 pounds per day which was slightly below the average June values recorded (Table 3). CPUE values were moderate (550 pounds per day) in statistical subareas 13 and 16, high (>600 pounds per day) in statistical subareas 15 and 17, and low (400 pounds per day) in subarea 14 (Fig. 13a). These trends and levels are similar to what has occurred during most other years. As in past years, over 95% of the production took place within 15 fm of water in each of the five statistical subareas (13-17) (Fig. 13b).

The July offshore fishery in statistical subareas 13-17 produced 4.9 million pounds of brown shrimp with an effort of about 8,100 days of fishing. This effort value was moderate, with the catch level also being near the average value experienced over the years (Table 3). Average CPUE was 603 pounds per day, which was near mid-range of other CPUE values during the 14 year period (Table 3). CPUE values were lowest in subareas 13 and 17 and highest in subarea 14-16 (Texas subareas not included in this discussion) (Fig. 14a). Catch was very similar in all subareas, with greatest effort in subareas 13 and 17. Most of the catch was in water shallower than 15 fm in all statistical subareas (Fig. 14b).

In August, the Louisiana offshore fishery produced approximately 2.6 million pounds of brown shrimp. Interview levels were low during this period (see interview section in this report) and effort could only be accurately estimated for statistical area 13 (1000 days). Average CPUE was only 432 pounds per day in subarea 13. Catch levels were very low in all statistical subareas except 17 (Fig. 14a and b).

Thus, during the May-August 1989 period, 20.5 million pounds of brown shrimp were landed from the offshore fishery. This catch level is high when compared to most other values since 1979. It exceeds all values except those from 1981, 1986 and 1987 (Table 3). Yet, this high catch came from a near record expenditure of effort. A total of nearly 40,000 days of fishing occurred during this four month period off Louisiana. Since



1974, only the effort exerted in the May-August 1979 period (42,300 days) exceeds this 1989 value (Table 3). With this high level of effort, CPUE values during this period averaged only 512 pounds per day. This is the third lowest average CPUE value since the Texas closure began. The 1983 average was 435 pounds per day and the 1988 average was 436 pounds per day.

### Texas

#### Brown Shrimp Inshore Fishery

Thus far in biological year 1989, 6.1 million pounds of brown shrimp have been landed from Texas bays. This is the fourth greatest catch ever recorded from Texas inshore waters. Monthly catches during 1989 were greatest in May and June with 2.2 million pounds in May and 2.3 million pounds in June. These two months accounted for 73% of the catch during the four month period. Landings were still quite high in July with 1.4 million pounds landed, but dropped off quickly in August with about 316.8 thousand pounds landed.

Like most other years, Matagorda Bay had the greatest inshore production this year during the May-August period, with a catch level of 1.9 million pounds. This is a 21% increase over last year's catch from the bay system. Aransas Bay recorded a similar inshore catch with 1.9 million pounds, while Galveston Bay had 1.4 million pounds of brown shrimp landed; a drop of 34% over last year. This year San Antonio Bay had catches again exceeding the one million pound level (1.2 million pounds), while Corpus Christi Bay only experienced 0.5 million pounds landed. Most of the landings this year occurred during the June period in all bay systems. Galveston Bay did not have significant inshore production in August as in past years. Only about 1 thousand pounds were landed in Galveston Bay; a major decrease compared to the 331 thousand pounds landed last year.

The size composition of the inshore catch during the 1989 season was different than last year, and most previous years since the time ESO agents began to collect data on the specific size categories larger than 68-count, but similar to 1987 (Table 6). Last year 45% of the total inshore catch during the May-June period was in the greater than 116 count size group. This year 70% of the catch during the same two month period was in this size group (the value in 1987 was 73%). Last year 36% of the entire May-August catch was composed of shrimp larger than 116 count, while this year the figure was 60%, which is similar to the 1987 value of 64%.

## Brown Shrimp Offshore Fishery

The 1989 offshore production from May through August amounted to 17.3 million pounds with 16.3 million pounds (94%) of the catch produced in the July through August period. This is different than the last three year's July through August percentages when a 15 mile closure was in effect (76% in 1986, 81% in 1987, 82% in 1988), but similar to most other years since 1981, which had 97% of the May through August total being taken in the July through August period (200 mile closure years). The four month catch total experienced this year was the third largest since the record catch noted in 1981 (25.3 million pounds) (Table 3).

In May 1989, a little under 0.8 million pounds of brown shrimp were landed with an effort of around 3,400 days fished. This produced a CPUE value of only 245 pounds per day. This is an average catch, associated with one of the greatest effort values observed since 1979 (Table 3). Landings were similar in all statistical subareas 18-21, while most of the effort was in subareas 19 and 21. Unlike last year, subarea 20 had the largest CPUE (Fig. 12a).

With the entire EEZ closed to shrimp trawling, June production was only 0.2 million pounds. This value is similar to most other June levels during 200 mile closure years, but reduced below catches experienced during pre-closure and 15 mile closure June periods (Table 3). Effort was below last years value of 3,700 days fished, with a value of only about 300 days fished. This effort value was similar to most 200 mile closure years for the month of June (Table 3). Average CPUE was only 539 pounds per day this year in June. Catch and effort were low in all statistical subareas (18-21) (Fig. 13a). The greatest CPUE values were in subareas 19 and 20 with around 600 pounds per day, while subarea 18 had only 400 pounds per day (Fig 13a).

Total catch in July was 7.3 million pounds with only 5,700 days fished. This is a moderate catch for the month of July (Table 3). The effort levels were low compared to the last few years (Table 3). About 0.2 million pounds (3% of the total) were caught before the closure opened on July 16th with about 100 days fished (2% of the total). After the closure opened, about 7.1 million pounds (97% of total) were caught with 5,500 days fished (98% of total). Thus, closure and post-closure periods in July had extremely unequal amounts of total effort and landings. CPUE during the post-closure July period average 1280 pounds per day. Both catch and effort were high in subarea 19, moderate in subarea 18 and low in subareas 20 and 21 (Fig. 14a). The greatest catch occurred in the 11-15 fm depth off statistical areas 18 and 19 (Fig. 14b). CPUE values were highest in subareas 20 and 21 (Fig. 14a).



In August, the offshore Texas catch was 9.0 million pounds of brown shrimp with an effort of about 10,200 days of fishing. CPUE was around 889 pounds per day. Catch and effort values were very high when compared to other August values, with CPUE also at the high end of the range (Table 3). As in years past, most production was concentrated in subarea 19 (Fig. 15b), but all subareas off Texas experienced very good CPUE values, with subarea 20 having the best at around 1000 pounds per day (Fig 15a).

### Texas-Louisiana Comparisons

#### Size of Shrimp

Smaller sized shrimp were caught in Texas inshore waters during the entire May through August period when compared to Louisiana inshore waters (Table 7). The average size count in May was 134 and 119 shrimp per pound in Texas and Louisiana, respectively, whereas in June the counts were 134 and 102 shrimp per pound. Count size dropped in both states in July, with an average of 107 shrimp per pound in Texas and 96 shrimp per pound in Louisiana. In August, values were 73 and 46 shrimp per pound for Texas and Louisiana, respectively. These are among the smallest average sized shrimp for Texas in many years, but were about average for Louisiana. Figures 16 and 17 show percent composition of total number for each size class by month for Louisiana and Texas, respectively.

The size composition of the commercial offshore catch of brown shrimp from statistical subareas 13-17 from May to August 1989 was dominated by greater than 116-count shrimp in May, >81 count shrimp in June and 68-100 count in July (Fig. 18). In August, the catch was more uniformly distributed among the size groups ranging from 41-80 count shrimp.

In statistical subareas 18-21 the commercial offshore catch from May to August 1989 was distributed equally over most size categories greater than 67 count in both May and June (Fig. 19). In July, the 31-40 count group range was the predominant modal group, with large number of medium shrimp landed. The dominant modal group in August was also 31-40 count. Count sizes experienced this July and August were similar to previous years.

In comparing the mean number of shrimp per pound from offshore waters in Texas and Louisiana, Texas always had smaller sized shrimp landed (Table 8). This is similar to what occurred during the 1987 season.

## Number of Shrimp

In addition to describing the pounds landed by size count, we have converted the size category information into estimated numbers of shrimp caught in Texas and Louisiana, both for offshore and inshore waters. Large numbers of shrimp were caught in Louisiana waters in May and June (about equal amounts inshore and offshore), with numbers decreasing drastically in July and August (Table 9). Overall, Louisiana caught over 2.8 billion shrimp in the four month period, with 82% being caught during the first 2 months.

Texas had around 200-400 million shrimp caught each month from its waters during the May through August period (Table 9). During the first 2 months, 91% of the total were caught from inshore waters, while during July, 67% of the total number of shrimp were taken from offshore waters. During August, numbers dropped off quickly compared to July, but again most (93%) of the shrimp were from offshore waters.

## Total Catch

May through August catches in 1989 from Louisiana and Texas were compared over the last 9 years (Table 10). Both offshore Louisiana and Texas experienced above average catches, with offshore Texas experiencing the third best catch and Louisiana experiencing its fourth best catch, since the record year of 1981. Inshore catches were about average for Louisiana during the period (only 11.3 million pounds), while inshore Texas had the third largest inshore catch ever recorded at 6.1 million pounds. Overall, Texas had a total catch of 23.4 million pounds for the four month period which was only below the values obtained in 1981, 1984 and 1987. Louisiana had a moderately high catch at 31.8 million pounds which was only below the values obtained in 1981, 1986 and 1987.

## INTERVIEW RATES

Interview rates of shrimp boat captains by NMFS port agents were greatly reduced during the 1989 season compared to past years. Interview rates of trips landing in Louisiana ports have averaged around 5% for the May-August period for several years, with that level experienced at most ports. During the 1989 May-August period less than 1% of the trips were interviewed. Extremely poor interview rates were experienced in May and August, with most ports having no interviews. Similar events occurred at Texas ports. Interview rates of trip landings in Texas ports have averaged around 23% for the July-August period for the past few years, with slightly higher interview rates from southern Texas ports. During the 1989 season interviews dropped to 10% in July and 14% in August.

Even with the decrease in interviews from Texas ports this past season, high enough numbers were obtained for the effort and CPUE values to be estimated with some confidence. However, effort and CPUE values from Louisiana are in question this year, with greatest doubts occurring for the May and August data.



## RESULTS - ANALYSIS

### IMPACT OF CLOSURE

#### Catch per Unit Effort Analysis

Changes in CPUE over several years before and after closure incorporate both recruitment variation and possible closure effects. However, as a first approximation, a "good year" in one area tends to be a "good year" throughout the Gulf. Therefore, examining the ratio of CPUE off Texas versus elsewhere will eliminate some of the effects of variation due to recruitment. In July the CPUE ratio has been near the mean of 1.3 during most years, with the exception of the early 1970's and the initial closure years (Fig. 20). During the 200 nautical mile EEZ closure period (1981-1985) the increase in CPUE (biomass build-up with closure) was an advantage to those individuals fishing in Texas offshore waters. This Texas advantage with higher than average CPUE, lasted until September 1981, but only until August in most other 200 nautical mile closure years. This indicated a more rapid utilization of the stock build-up in later years. With the opening of the EEZ from 200 nautical miles to 15 nautical miles in 1986, 1987, and 1988, the Texas advantage (biomass build-up because of the closure) was lost (Fig. 20). This was also evident when August CPUE ratios were calculated (Fig. 21). Values during all three 15 mile closure years (1986, 1987, and 1988) were very near the pre-closure average of 1.1 during the August period. Thus, the potential increase in harvest of larger shrimp was exchanged for the access to offshore waters in May and June during the three 15-mile closure seasons. With the return of the 200 mile closure this past season, a biomass build-up again occurred off the Texas coast in July and probably into August.

#### Gulf-Wide Yields - EEZ Closure

During 1988 the EEZ was closed only out to 15 nautical miles, where as in 1989 the EEZ was closed out to 200 miles. For all analysis purposes, we have treated 1988 as if the entire EEZ was opened (i.e., only state waters closed). June catch and effort data support this assumption, since these values are similar to other June values during pre-closure years (Table 3).

The major difficulty in evaluating the effect of the closure of the EEZ on the fishery is due to the variations in recruitment from year to year. The most direct and effective way to account for variation in recruitment is to estimate recruitment strength via virtual population analysis (VPA). Once this has been done the estimated recruitment can be fished through the computer simulation with or without the 200 nautical mile closure in effect.



The underlying VPA assessment (Nance and Nichols, 1987) was updated through August 1989. Procedures for estimating "starting F" were identical to those used in previous analysis. The same procedure used last year for assessing what fishing mortality would have been with a total closure of the EEZ was repeated (Nichols, 1987) for the 1988 data. The same procedure used in 1985 for assessing what fishing mortality would have been without a closure of the EEZ was repeated for the 1989 data (Nichols, 1986). July effort was used as the maximum available estimate in a given year when compared to baseline years. It has become apparent over the last few years that maximum Gulf effort has shifted from August to July in the brown shrimp fishery.

To determine the effect of a 200 nautical mile EEZ during the 1988 biological year (May 1988-April 1989), a 1984 baseline was chosen to simulate the fishing mortality rates during the closure period. This baseline year had similar effort and recruitment when compared to the analysis year. Starting F values in 1984 were adjusted by a July multiplier of 1.124. Analysis indicated that in the May-April period, 0.12 million pounds of small shrimp (>67 count) would be caught with the closure, a gain of 0.46 million pounds of medium shrimp (31-67 count) and a gain of 3.05 million pounds of large shrimp ( $\leq 30$  count) would occur (Fig. 22). Thus, an overall increase of 3.64 million pounds would result in the May-April period with the total closure.

For the 1989 biological year (May 1989-April 1990), 1987 was used as the baseline year and average fishing mortality rates were multiplied by the July multiplier of 1.178 (ratio of July effort in 1989 compared to 1987). Fishing mortality off Louisiana was held constant, since both baseline and current year had dissimilar fishing patterns in the 5 fathom area near the Mississippi River. Analysis indicated that in the May-August 1989 period 1.91 million pounds of small shrimp (>67 count) would be passed up with the closure in effect, 2.37 million pounds of medium shrimp (31-67 count) would be caught, and a loss of 0.06 million pounds of large shrimp ( $\leq 30$  count) would occur (Fig. 23). Thus, a net increase of 0.40 million pounds resulted in the May-August period with the total closure. Projections for the May-April period are shown in Figure 24. A net increase of 0.78 million pounds is the indicated gain without a complete closure of the EEZ. A loss of 1.91 million pounds of small shrimp (>67 count) would occur, along with a gain of medium shrimp of 2.55 million pounds. A gain in large shrimp of 0.14 million pounds would also occur if the 200 mile closure was not in effect.

### Effort Displacement

The Texas share of the June offshore effort fell to all time low levels during the 200 nautical mile EEZ closure (1981-1985), but this basically continued a decreasing trend that began

several years before (Fig. 25). Effort off Texas averaged only 23% of the Gulf-wide June effort from 1976-1980. Quite likely then, 23% of the Gulf-wide effort was subject to displacement by the total EEZ closure. With reopening of the EEZ beyond 15 nautical miles in 1986, 1987, and 1988, the fraction of effort off Texas rebounded to levels above the 1976-1980 average. With the 200 mile closure in effect this past season the fraction of effort off Texas decreased to around 2%.

### Finfish By-Catch

Previous studies have been made on by-catch of finfish during offshore shrimp trawling operations. Moore et al. (1970) estimated an annual finfish catch rate off Texas of 77 lbs/hr. Blomo and Nichols (1974) estimated an annual fish discard of between 52 and 368 million pounds in the western Gulf of Mexico. Chittenden and McEachran (1976) analyzed by-catch on both the white and brown shrimp grounds off Texas from 1973 to 1974 and reported an estimated annual (1962-1971) finfish discard of 482.0 million pounds off Texas. Bryan et al. (1982) reported an overall mean catch rate of  $56.7 \pm 7.7$  lbs/hr in 1973-1974 on the Texas brown shrimp grounds. Watts and Pellegrin (1982) analyzed historical (1973-1978) and contemporary (1980-1981) by-catch data and reported on finfish catch rates and finfish/shrimp ratios.

Moore et al. (1970) supplied finfish catch rates by month and by depth. We used these data to obtain historical June finfish catch rates for the Texas coast by depth zone. Current finfish catch rates were obtained from 1989 Oregon II cruise data.

Finfish production off Texas during a 200 mile and a 15 mile closure were calculated using both historical and current estimates of finfish CPUE (Table 11). It appears that finfish catches during a 15 mile closure are greater than during a 200 mile closure. Based on historical CPUE, catches in the 15 mile closure were almost 4 times greater than during the 200 mile closure. Using current catch rates, finfish production during a 15 mile closure were about 2 times greater than catches during the 200 mile closure. It should be pointed out that the historical and current finfish catch rates used were obtained aboard research or contract vessels. Locations of sampling sites were determined arbitrarily - not necessarily in specific locations of peak shrimp production. Six out of the 40 subareas or cells were deleted (i.e. no data) from our production estimate.

Estimated by-catch of finfish by species during the 200 mile and 15 mile closures was calculated by using historical and current catch rates (Table 12). It appears that nearshore species catches were generally 2 times greater during the 15 mile closure than during the 200 mile closure. Offshore species



catches were from 3.5 to 10.6 times greater during the 15 mile closure than during the 200 mile closure.

It would appear that the 200 mile closure had a positive effect on finfish populations; however, pulse fishing after the closure (July and August) could result in significantly higher catches of finfish than during the 15 mile closure since these are the months of greatest shrimping activity.

## VESSEL MOBILITY/ACTIVITY

### State Landings

Commercial shrimp statistics are recorded with a given state and can be traced to the location of capture. We have utilized these data to depict the percent of each state's landings and its location of capture from June through August 1989 (Table 13).

Shrimp landings in the state of Texas that were from offshore production totaled 2.1 million pounds in June, 9.3 million pounds in July and 8.9 million pounds in August. In the June period, 10% of the shrimp landed in Texas were caught off Texas, with 89% of the shrimp being caught off Louisiana. A greater percentage was caught off Louisiana this June when compared to the last three Junes (53% off Texas in 1986, 64% off Texas in 1987, 77% off Texas in 1988): (Klima et al., 1987; Nance et al., 1988; Nance et al., 1989). During July about 75% of the shrimp landed in Texas were from Texas waters and 25% were from Louisiana waters. During August the percentage of shrimp landed in Texas that was caught off Texas raised to 92% and the percentage caught off Louisiana dropped to 8%. Again, percentage of shrimp taken off Louisiana during July and August 1989 were usually higher when compared to values from the July-August period in 1986, 1987 and 1988.

Percentages of 1989 Texas landings caught off each state during the June-August period were compared to percentage values obtained over the previous five years (Fig. 26). During June 1984 and 1985, when the total EEZ was closed off Texas, only a small percentage (11-19%) of the brown shrimp landed in Texas were from Texas waters, while the majority (81-89%) were from Louisiana waters. During June of each of the recent 15 mile closure periods, the percentage of shrimp landing in Texas that were caught off Texas increased (55% in 1986, 64% in 1987 and 77% in 1988). June values during 1989 are similar to other 200 mile closure years. During all the July-August periods, with the exception of 1986 and July 1989, greater than 80% of the shrimp landed in Texas were caught off Texas. The reason for the decrease in 1986 values was because of the record catches that were occurring off the state of Louisiana and only average catches off Texas. The reason for the decrease in the July 1989 value was probably because of the mid-July opening of the

closure. Most of the landings from Louisiana were during the first two weeks of July. During 1984 and 1985 the closure opened during the first part of July (Table 1).

Shrimp landings in the state of Louisiana that were from offshore production totaled 6.1 million pounds in July, and 4.3 million pounds in August (Table 13). During June about 99% of the shrimp landed in Louisiana were caught in Louisiana waters. During July the percent of Louisiana landings caught off Louisiana decreased to about 86% and remained at this level during August.

When 1989 Louisiana landing values were compared to 1984-1988 values, some detectable differences were seen. During all five June periods greater than 95% of the shrimp landed in Louisiana were caught from Louisiana waters. During 200 mile closure years this percentage dropped to around 85% in July and then rose to around 90% in August. During the three 15 mile closure years the percentage in July and August remained in the high 90% range.

Shrimp landings in Mississippi from offshore production were mainly caught off Mississippi during the June-August period (Table 13). Shrimp landings in Alabama, on the other hand, were caught in the greatest numbers off both Mississippi and Louisiana in June, with about 20-40% of the catches from Texas waters during the July-August period. Florida landings were similar to those shown for Mississippi. Most of the shrimp landed in Florida during the June-July period were caught off Florida. This level dropped to around 75% in August with an increase in the "shrimp taken off Texas" category.

#### Home Port

We have further been able to identify the home port of most vessels from each of the Gulf coast states and have made a determination of the percentage and pounds landed from June 1 through August 31, 1989 by each selected group (Texas, Louisiana, and other) (Table 14). The unknown category is a conglomerate of information from consolidated schedules and, as a result, most probably comprises catches from boats and vessels fishing in their respective states.

During June 1989, about 84% of the 2.06 million pounds of shrimp landed in Texas were caught by vessels with Texas home ports. About 9% of the catch came from Texas waters, while 75% came from Louisiana waters. On the other hand, only 32% of the 5.25 million pounds of shrimp landed in Louisiana were caught by known Louisiana home port vessels. The "unknown" category accounted for 59% of the catch. This category was rather large this year, but is most likely composed mainly of Louisiana vessels and maybe a few from states other than Texas. If true,



then around 91% of the catch landed in Louisiana was from Louisiana home port vessels. This is consistent with data from most other years.

Landings of shrimp increased in Texas during July with 9.3 million pounds landed. This was a 14% increase from landings last year. Around 76% of the shrimp landed in Texas were from Texas vessels, while 1% were from Louisiana vessels and 10% from vessels from other Gulf states.

In Louisiana during July, about 3.8 million pounds of shrimp were landed, which was similar to last years value. Texas vessels accounted for 4% of the catch, while Louisiana vessels probably accounted for 95% (57% unknown) of the catch. Other Gulf state vessels only landed about 1% of the months landings.

Landings dropped off in both states during August. In Texas 8.9 million pounds of shrimp were landed. However, this represented a 35% increase over landings from last August. About 82% of the landings came from Texas vessels, with 75% from Texas waters and 7% from Louisiana waters. Louisiana vessels accounted for only 2% of the Texas landings and other Gulf state vessels landed about 7% of the total. In Louisiana a little over 4.2 million pounds were landed, with Texas vessel landings only around 2% of the total. Louisiana vessels probably accounted for 97% of the landings (59% unknown), with other Gulf states landing about 1% of the total.

Percentage data from the June-August 1989 period were similar to other 200 mile closure year data in most cases. In general, most of the shrimp landed in the state of Texas are harvested off the state of Louisiana during the June period, with the bulk taken from Texas waters in July and August. The majority of the June-August landings in Louisiana are, as shown in past years, taken off Louisiana by Louisiana vessels.

## DISCUSSION

The current FMP lists four criteria that are to be considered by the GMFMC in reaching a decision about whether or not to recommend an EEZ closure in cooperation with the closure in state waters off Texas. These criteria are:

1. Benefits in increased pounds of shrimp caught and/or gross and/or net value to the industry resulting from the closure.
2. Adverse effects from an increase in fishing pressure as a result of the closure which causes a decrease in catch per unit effort.
3. Adverse effects from stress on support facilities for the shrimp fleet because of fleet migration resulting from closure.
4. Any other information determined by the Regional Director to be relevant.

The discussion of results in this report will be formatted in such a way that relevant material will be placed under sub-areas which in most cases correspond to each of the listed criteria.

## HISTORICAL PERSPECTIVE

The 1988 and 1989 catch levels of brown shrimp differed when values were compared with the values from other closure years during the summer period. The Louisiana brown shrimp catch from May-August 1988 for the inshore and offshore areas was around 28.9 million pounds (14.0 inshore and 14.9 offshore), whereas in 1989 the total catch of brown shrimp for the same period was 31.8 million pounds (11.3 inshore and 20.5 offshore) (Table 10). Both years had above average total catches but, in 1989 inshore catches were below average and offshore were above average, while in 1988 inshore catches were above average and offshore catches were slightly below average.

In Texas during the May-August 1988 summer period, a moderate total catch of 22.1 million pounds occurred (6.9 inshore and 15.2 offshore), whereas in 1989 the total rose slightly with about 23.4 million pounds taken (6.1 inshore and 17.3 offshore) (Table 10). Catches from inshore waters during both years were very high when compared with other years.

In both 1988 and 1989 between 7 and 8 million pounds more shrimp were harvested from Louisiana waters than from Texas waters during the summer period. The difference between offshore landings from the two states was only about 0.3 million pounds in



1988, but 3.2 million pounds in 1989. Inshore harvest from Louisiana again caused the major difference in landing between the two states. In 1989 the difference was 7.1 million pounds, but in 1989 it was only 5.2 million pounds.

Effort in the brown shrimp offshore fishery this year (1989) far exceeded levels usually experienced during the summer period (Table 15). Yet, it was not clear what caused the increase. One possible explanation is that the closure itself caused the increase. Although possible, the major effect from the closure is a shift in existing effort and not a change in it. Another possible explanation for the increase was lack of interviews this past season. Effort values estimated off Texas seems reasonable and although interview levels were low, they were probably adequate to estimate effort levels. Effort levels off Louisiana seem unreasonably high and are most likely due to poor estimates because of the lack of interviews. Offshore Louisiana experienced a major increase in effort during the May-June 1989 period. Texas experienced a decrease in May-June 1989 effort compared to last year, but it was higher than the average when compared to the other 200 mile closure years. Louisiana had slightly higher effort in July this year compared to last year, but August was greatly reduced. Effort off Texas in July 1989 was comparable to other 200 mile years, but was above average in August. It should be remembered that a steady increase in fishing effort has been observed in the brown shrimp fishery for several years (Nance and Nichols, 1987). This increase in effort will greatly impacted the benefits of the Texas closure regulations for individual fishermen.

CPUE values were computed for the offshore brown shrimp fisheries in Louisiana and Texas (Table 15). Note the reduction in CPUE experienced for the past two years in Louisiana, even with the average to above average shrimp landings (Table 10). Notice the decrease in CPUE off Texas in July with the closure at 15 nautical miles (1986, 1987 and 1988) instead of the 200 nautical mile closure (1981-1985, 1989) (Table 15).

The average size of shrimp taken in the offshore waters of both Texas and Louisiana during the May-August 1989 period was smaller than shrimp taken during the same period in most other years, except during 1987. In Texas during May and June 1988, the average size was 50 count and 49 count respectively, whereas in 1989, the average size was 57 count in May and 75 count in June. In July and August 1989 average sizes were 42 count and 37 count respectively, which was not much different from 1987 or 1988.

Size of shrimp caught in Texas inshore waters were also similar in 1989 when compared to 1987. During May 1989 average size was 134 count, whereas last year it was 120 count. June, July and August also had similar results with 134 count, 107



count and 73 count respectively in 1989, and 125 count, 94 count and 71 count respectively in 1987. Louisiana sizes were all smaller compared to last year, but were larger than shrimp from Texas during all months (Table 6). This is the second year that Louisiana inshore fishermen have caught larger sized shrimp when compared to Texas inshore fishermen.

### BENEFITS OF CLOSURE

Impacts of the closure analyses this year showed no build-up of biomass off Texas in 1988 with a 15 nautical mile closure, compared to the build-up experienced during the 200 nautical mile closures (Figs. 20 and 21). Thus, the potential increase in harvest of larger shrimp was exchanged for access to offshore waters in May and June during the 1986-1988 seasons. The build-up was again experienced in 1989 with the 200 mile closure in effect.

Last year an increase of around 3.64 million pounds would have resulted during the May 1988-April 1989 period with a total closure of the EEZ off Texas. Analysis indicated that if the 200 mile closure would have been in effect during the summer of 1988 that 0.12 million pounds of small shrimp (>67 count) would have been caught with the closure, a gain of 0.46 million pounds of medium shrimp (13-67 count) and a gain of 3.05 million pounds of large shrimp ( $\leq 30$  count) would have occurred because of a closure (Fig. 23).

For the 1989 biological year (May 1989-April 1990), results indicated that during the May-August period, 1.91 million pounds of small shrimp (>67 count) would be passed up with the closure in effect, 2.37 million pounds of medium shrimp (31-67 count) would be caught, and a loss of 0.06 million pounds of large shrimp ( $\leq 30$  count) would be experienced without the total closure (Fig. 24). An overall net increase of 0.40 million pounds would be the predicted result in the May-August 1989 period with the total closure. Projections for the May 1989-April 1990 period show a total increase of around 0.78 million pounds with a 200 mile closure (Fig. 25). A loss of 1.91 million pounds of small shrimp (>67 count) would occur, along with a gain of medium shrimp (31-67 count) of around 2.55 million pounds. A gain of 0.14 million pounds in the large shrimp group ( $\leq 30$  count) would also occur if the 200 mile closure was not in effect.

### ADVERSE EFFECTS OF CLOSURE

All analyses show that effort has increased Gulf wide, with an overall decrease in CPUE. This change has occurred not because of the combined closure off Texas, but in response to the increase in vessels fishing the offshore waters. Thus, it seems that no adverse effects on CPUE or effort have occurred because of closure regulations.

Analysis of vessel mobility showed that with the 15 mile closure, offshore vessels were starting to fish to a greater extent in home state waters each year. Many Texas vessels fished in Louisiana in 1986 to take advantage of the higher catch rates off Louisiana compared to Texas (Klima, et al., 1987). During 1987 and 1988 more and more vessels seem to be fishing in home state waters. With the 200 mile closure this year, vessel mobility seemed comparable to other 200 mile closure years. Texas vessels seemed to fish off Louisiana during the closure period, but quickly migrated back to Texas waters when the closure opened. Many vessels moved into Texas waters when the closure opened, with about 11% of the Texas landings coming from out of state vessels.

The 200 mile closure causes shifts to take place with regards to where brown shrimp effort is occurring in the Gulf of Mexico. To some extent it may be argued that any decrease in brown shrimp effort noted in a given year during the closure period, may have been allocated to a different fishery and may have an adverse effect on that fishery.

As mentioned earlier, when the Texas closure is in effect, there is a day-time fishery for white shrimp still occurring in the shallow waters off the state of Texas. There has been an increase in the directed effort for white shrimp off Texas during most of the closure years (1982-1986), but a similar increase was also noted during the 1968-1972 period (Fig. 27). Total shrimping effort (brown and white) is greatest in this shallow water area during the 15 mile closure years (Fig 28). No real change has occurred with regards to size of white shrimp landed during the closure period (Fig. 29), although a decrease in pounds caught has occurred the last few years (Fig. 30). Recruitment<sup>4</sup> of white shrimp off the Texas coast has declined the last three years, but levels are not below other low periods during non-closure years (Fig. 31). Thus, although an impact may be taking place, it is difficult to conclude that the closure of the brown shrimp fishery off Texas is impacting the white shrimp fishery in a negative way off the same state. The environment probably plays a major role in strength of recruitment of white shrimp to the fishery each year (Nance, et al., 1989b).

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<sup>4</sup>To measure recruitment of a stock for a given area, you must partition the total stock into sub stocks for each area and assume no interchange occurs between the areas.



## OTHER RELEVANT INFORMATION

### 15 Mile vs 200 Mile Closure

When 200 mile closure years (1981-1985, 1989) are compared with 15 mile closure years (1986-1988) some striking differences appear. The first difference is that much higher July CPUE's are experienced off Texas during 200 mile years (>1,000 pounds/day) when compared to 15 mile years (averaged 857 pounds/day) (Table 14). August CPUE values are comparable between the two closure types (excluding 1981) with the average around 685 pounds per day for 200 mile closure years and 662 pounds per day for 15 mile closure periods.

Effort has increased tremendously over the past few years. This however, has been a Gulf wide increase and has occurred along with an increase in the number of vessels fishing in the Gulf of Mexico. Thus, this is not an effect of a particular closure type. However, total shrimping effort is greater in the shallow waters off Texas during 15 mile closure years (Fig. 28).

Another difference between the two closure types is, as expected, the pounds and size of shrimp taken off Texas during the closed period (Fig. 32). About 20% of the shrimp caught during the closure period of the 15 mile closure years are small shrimp (>67 count).

## SUMMARY

### THE 1988 FISHERY

In 1988, the total Louisiana May-August catch was 28.9 million pounds compared to 22.1 million pounds in Texas. Catch levels in offshore waters were only slightly different between areas 13-17 and 18-21. This similarity in production set the tone for the summer offshore fishery.

Fishing effort was greater off both Louisiana and Texas this year compared to most other years. This increase in effort with only average to slightly above average catch produced poorer than normal CPUE values in both areas.

The catch off Texas in July-August 1988 amounted to 12.5 million pounds. This represents an average catch for the area during this period. The average CPUE for this period was only 684 pounds/day. A rather low value when compared to other years.

The July-August catch off Louisiana amounted to 8.3 million pounds with a average CPUE of 538 pounds/day. In most closure years including 1987 and 1988, the CPUE off Texas has been at least 1.5-2.0 times greater than off Louisiana.

The average size of shrimp in July and August off Louisiana was 49 and 40 per pound, respectively, whereas off Texas the average count was 43 in July and 37 in August.

Home port information indicated that during the June 1 through August 31 period Louisiana vessels predominantly landed in Louisiana and very few Texas vessels landed in Louisiana. Likewise, Texas vessels predominantly caught the majority of shrimp landed in Texas. Louisiana vessels rarely landed in Texas. Overall probably >90% of the offshore landings in Louisiana were caught by Louisiana vessels and between 80-90% of the Texas landings were caught by Texas vessels.

A net increase of about 3.64 million pounds, would have resulted in the May-April 1989 period with a total closure of the EEZ.

### THE 1989 FISHERY

During 1989, the closure off the state of Texas was out to 200 nautical miles. The total Louisiana May-August catch was 31.8 million pounds compared to 23.4 million pounds in Texas. The majority of the catch was taken in the offshore waters of both states (64% in Louisiana and 74% in Texas).



Fishing effort was extremely high off Louisiana and moderately high for a 200 mile closure year off Texas. Moderate CPUE values were experienced off Louisiana in July and August, while excellent CPUE values were obtained from the waters off the state of Texas during the July and August period.

The average size of shrimp in July and August off Louisiana was 60 and 46 per pound, respectively, whereas off Texas the average count was 42 in July and 37 in August 1989.

Home port information indicated that during the June 1 through June 30 period that most of the landings in Texas came from the waters off Louisiana, while after the closure, Texas vessels began to fish in and land shrimp from home waters in greater abundance. During the entire period the majority of Louisiana vessels remained in and landed shrimp from home waters.

A net increase of 0.40 million pounds is indicated during the May-August period with a complete closure of the EEZ. Projections for the May-April period show an overall net increase of 0.78 million pounds with the closure in effect.

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Table 1. Comparison of Texas closure dates.

Closure Year	Dates Closed	Length in Days
1981	May 22-July 15	55
1982	May 25-July 14	51
1983	May 25-July 15	50
1984	May 16-July 6	52
1985	May 20-July 8	50
1986	May 10-July 2	54
1987	June 1-July 15	45
1988	June 1-July 15	45
1989	June 1-July 15	45



Table 2. Total offshore brown shrimp landings in millions of pounds, total fishing effort in 1000's of days and CPUE in lbs/day, for Louisiana statistical subareas 13-17, and Texas statistical subareas 18-21 for 1976-1989 (1980 not included).

Area	Jan.		Feb.		March		Apr.	
	13-17	18-21	13-17	18-21	13-17	18-21	13-17	18-21
1976								
Catch	0.8	0.5	0.6	0.6	0.4	0.4	0.5	0.5
Effort	1.4	1.3	1.3	2.0	1.0	1.7	1.2	2.1
CPUE	534	384	501	289	401	245	370	227
1977								
Catch	0.5	0.2	0.4	0.2	0.5	0.1	0.4	0.3
Effort	1.8	1.0	1.6	0.9	1.8	0.7	1.8	1.5
CPUE	296	193	249	163	274	149	232	201
1978								
Catch	0.9	0.7	1.1	0.5	1.4	1.2	0.5	0.4
Effort	1.1	2.0	2.1	1.3	3.4	0.9	1.2	1.6
CPUE	836	353	531	371	413	174	438	247
1979								
Catch	0.7	0.7	1.0	0.6	0.8	0.5	0.6	0.4
Effort	1.9	2.3	2.0	2.4	2.3	2.1	2.0	1.5
CPUE	374	312	524	266	361	235	312	293
1981								
Catch	0.2	0.3	0.1	0.1	0.2	0.1	0.1	0.1
Effort	0.6	1.0	0.4	0.4	0.4	0.3	0.0	0.2
CPUE	319	253	329	296	387	228	195	301
1982								
Catch	0.5	0.6	0.6	0.6	0.4	0.2	0.2	0.2
Effort	0.9	1.4	1.2	1.9	1.1	0.6	0.7	0.8
CPUE	549	454	446	317	370	276	281	271
1983								
Catch	0.4	0.3	0.3	0.2	0.4	0.1	0.3	0.2
Effort	1.2	1.0	1.2	1.0	1.1	0.5	0.8	0.8
CPUE	373	261	281	206	331	255	346	215
1984								
Catch	0.4	0.2	0.4	0.2	0.3	0.1	0.3	0.3
Effort	0.8	1.2	0.9	0.9	0.8	0.6	0.8	1.2
CPUE	502	196	382	236	326	227	366	74
1985								
Catch	0.6	0.4	0.5	0.3	0.4	0.2	0.4	0.4
Effort	0.8	1.1	1.3	0.9	1.4	0.9	0.9	0.9
CPUE	734	357	405	326	298	267	519	464
1986								
Catch	1.4	0.9	1.0	1.0	0.8	0.6	0.4	0.8
Effort	2.9	1.6	2.1	2.5	1.5	1.9	0.9	2.2
CPUE	478	547	508	387	497	330	470	349
1987								
Catch	0.5	1.0	0.6	0.8	0.6	0.4	0.3	0.5
Effort	1.1	2.8	2.1	2.6	2.7	2.1	1.4	1.9
CPUE	459	347	308	304	239	199	189	248
1988								
Catch	0.5	0.5	0.5	0.6	0.2	0.3	0.3	0.4
Effort	1.5	1.8	2.1	2.5	1.3	1.5	1.5	2.3
CPUE	320	254	231	223	180	176	175	188
1989								
Catch	0.4	0.4	0.5	0.3	0.4	0.2	0.3	0.3
Effort	2.7	2.1	1.9	1.5	1.8	1.1	1.6	1.2
CPUE	165	173	262	210	204	202	160	222

Table 2 (cont'd).

Total offshore brown shrimp landings in millions of pounds, total fishing effort in 1000's of days and CPUE in lbs/day, for Louisiana statistical subareas 13-17, and Texas statistical subareas 18-21 for 1976-1989 (1980 not included).

Area	May		June		July		Aug.	
	13-17	18-21	13-17	18-21	13-17	18-21	13-17	18-21
1976								
Catch	1.4	0.8	3.8	1.2	4.8	6.2	3.1	5.3
Effort	3.2	3.1	5.0	2.5	5.4	7.4	3.6	8.8
CPUE	456	246	770	497	880	839	866	607
1977								
Catch	3.6	0.5	6.4	2.1	5.9	8.6	5.9	8.1
Effort	4.3	3.6	7.7	2.8	6.3	7.5	6.3	9.0
CPUE	839	150	835	771	935	1147	943	891
1978								
Catch	5.3	0.8	5.6	2.6	8.5	5.4	5.1	6.3
Effort	7.7	3.8	8.0	3.8	9.0	5.5	7.2	8.4
CPUE	685	217	708	677	941	982	713	746
1979								
Catch	4.1	0.9	5.7	1.9	4.2	3.9	5.3	3.5
Effort	7.6	3.2	10.4	3.3	14.7	5.6	9.6	6.3
CPUE	536	271	554	582	285	685	555	548
1981								
Catch	5.0	0.4	7.6	-	7.5	10.4	3.0	14.6
Effort	5.8	1.1	9.0	-	8.1	4.4	3.8	10.4
CPUE	861	308	842	-	927	2282	799	1408
1982								
Catch	3.3	0.8	5.3	-	3.3	6.6	1.8	6.4
Effort	5.4	2.6	8.8	-	6.4	5.2	3.4	10.2
CPUE	609	295	604	-	525	1279	522	629
1983								
Catch	1.0	0.5	2.9	0.2	2.6	5.2	2.3	4.8
Effort	2.5	1.8	6.6	0.5	4.2	3.7	4.9	6.7
CPUE	417	294	441	163	415	1414	470	714
1984								
Catch	2.6	0.6	4.5	0.2	3.8	8.8	2.7	6.5
Effort	3.3	2.1	6.5	0.3	6.4	8.2	4.7	9.0
CPUE	769	275	691	748	598	1074	573	723
1985								
Catch	6.9	0.6	4.0	-	3.0	8.2	2.5	5.6
Effort	5.7	1.5	5.4	-	4.9	6.8	3.7	8.4
CPUE	1221	391	732	-	612	1223	682	672
1986								
Catch	7.8	1.0	5.4	2.3	6.3	5.7	3.3	5.0
Effort	8.0	2.6	7.9	3.7	7.5	6.3	4.3	6.2
CPUE	978	390	691	628	840	896	773	799
1987								
Catch	4.9	0.9	6.6	2.4	6.0	8.9	3.3	5.3
Effort	7.9	3.1	11.1	4.6	10.0	9.9	5.8	8.2
CPUE	618	300	595	519	595	905	577	653
1988								
Catch	2.2	1.1	4.4	1.6	4.2	7.5	4.2	5.0
Effort	8.6	3.4	10.2	3.7	7.5	9.6	8.0	8.7
CPUE	259	319	431	431	556	781	521	578
1989								
Catch	6.7	0.8	6.2	0.2	4.9	7.3	2.6	9.0
Effort	17.6	3.4	10.9	0.3	8.2	5.7	3.3	10.2
CPUE	381	245	571	539	603	1276	809	889



Table 2 (cont'd).

Total offshore brown shrimp landings in millions of pounds, total fishing effort in 1000's of days and CPUE in lbs/day, for Louisiana statistical subareas 13-17, and Texas statistical subareas 18-21 for 1976-1989 (1980 not included).

Area	Totals and Averages for Jan.-Apr.		Totals and Averages for May-June		Totals and Averages for July-Aug.		Totals and Averages for Sept.-Dec.	
	13-17	18-21	13-17	18-21	13-17	18-21	13-17	18-21
1976								
Catch	2.3	2.0	5.2	2.0	7.9	11.5	5.7	10.7
Effort	4.9	7.1	8.2	5.6	9.0	16.5	9.6	19.1
CPUE	452	286	613	372	873	723	590	504
1977								
Catch	1.8	0.8	10.0	2.6	11.8	16.7	5.8	12.6
Effort	7.0	4.1	12.0	6.5	12.6	16.5	8.1	20.7
CPUE	263	177	837	461	939	1019	765	586
1978								
Catch	3.9	1.8	10.9	3.4	13.6	11.7	4.1	10.9
Effort	7.8	5.8	15.7	7.6	16.2	13.9	8.9	24.4
CPUE	555	286	697	447	827	864	451	436
1979								
Catch	3.1	2.2	9.8	2.8	9.5	7.4	4.1	6.4
Effort	8.2	8.3	18.0	6.5	24.3	11.9	11.2	15.0
CPUE	393	277	545	427	420	617	387	420
1981								
Catch	0.6	0.5	12.6	0.4	10.5	25.0	4.3	14.1
Effort	1.8	1.9	14.8	1.1	11.9	14.8	6.6	12.1
CPUE	308	269	852	308	863	1895	654	648
1982								
Catch	1.7	1.6	8.6	0.8	5.1	13.1	2.8	7.3
Effort	3.9	4.7	14.2	2.6	9.8	15.7	6.2	18.0
CPUE	412	330	607	295	524	922	447	403
1983								
Catch	1.4	0.8	3.9	0.7	4.9	9.9	2.5	6.6
Effort	4.3	3.3	9.1	2.3	11.2	10.3	4.7	14.6
CPUE	326	242	430	310	439	962	526	452
1984								
Catch	1.3	0.9	7.1	0.8	6.6	15.3	2.7	5.2
Effort	3.4	3.9	9.8	2.4	11.2	18.6	4.7	14.2
CPUE	395	224	718	295	587	819	575	366
1985								
Catch	2.0	1.4	10.9	0.6	6.1	14.0	3.4	9.7
Effort	4.4	3.8	11.1	1.5	9.7	15.2	5.3	15.5
CPUE	459	353	982	389	625	918	642	626
1986								
Catch	3.6	3.3	13.2	3.3	9.6	10.7	4.8	10.5
Effort	7.5	8.4	15.9	6.3	11.8	12.5	8.0	16.8
CPUE	480	393	830	524	813	856	600	625
1987								
Catch	2.0	2.7	11.5	3.3	9.3	14.2	5.1	8.1
Effort	7.3	9.4	19.0	7.7	15.8	18.1	13.8	20.7
CPUE	274	287	605	429	589	789	366	417
1988								
Catch	1.5	1.7	6.6	2.7	8.3	12.5	3.7	7.8
Effort	6.3	8.1	18.8	7.1	15.4	18.2	9.3	16.1
CPUE	228	211	351	383	538	684	403	485
1989								
Catch	1.6	1.2	13.0	1.0	7.5	16.3	-	-
Effort	8.1	5.9	28.5	3.8	11.5	15.9	-	-
CPUE	196	198	454	273	652	1028	-	-

Table 3. Galveston Bay shrimp index values from 1960-1989  
(average catch from 1960-1988 = 26.8 million pounds).

Year	Bait index	Predicted catch in millions of pounds	Actual catch in millions of pounds	Difference in millions of pounds
1960	53.6	29.1	34.5	+5.4
1961	20.8	20.0	13.2	-6.8
1962	26.1	21.5	17.3	-4.2
1963	53.0	29.0	24.6	-4.4
1964	30.2	22.6	18.6	-3.9
1965	41.0	25.6	26.5	+0.9
1966	-	-	31.5	-
1967	89.4	39.0	42.7	+3.7
1968	28.0	22.0	27.9	+5.9
1969	43.5	26.3	24.7	-1.6
1970	70.0	33.7	30.7	-3.0
1971	82.3	37.1	34.5	-2.6
1972	85.6	38.0	35.5	-2.5
1973	18.7	19.4	23.3	+3.9
1974	34.3	23.8	26.4	+2.6
1975	-	-	23.7	-
1976	34.1	23.8	25.7	+1.9
1977	58.1	30.5	34.3	+3.9
1978	40.5	25.5	27.7	+2.2
1979	-	-	16.5	-
1980	45.0	26.7	25.7	-1.0
1981	54.3	29.3	40.0	+10.7
1982	26.3	21.5	21.8	+0.3
1983	12.7	17.8	18.2	+0.4
1984	31.2	22.9	24.1	+1.2
1985	44.9*	29.0	30.4	+1.4
1986	37.2	25.3	27.1	+1.8
1987	38.6	25.7	27.2	+1.5
1988	41.9	25.9	22.5	-3.4
1989	31.8	23.1	NA	NA

\* Modified index



Table 4. Louisiana May catch index values from 1960-1989  
(average catch from 1960-1988 = 27.8 million pounds).

Year	Catch index	Predicted catch millions of pounds	Actual catch millions of pounds	Difference
1960	2.16	---	15.99	----
1961	1.57	---	9.15	----
1962	2.54	---	7.26	----
1963	4.86	---	16.87	----
1964	1.97	---	9.59	----
1965	3.13	---	17.84	----
1966	2.56	---	19.07	----
1967	7.61	---	30.61	----
1968	4.76	---	25.42	----
1969	4.58	---	25.18	----
1970	5.23	---	28.09	----
1971	5.55	---	30.74	----
1972	5.87	---	32.45	----
1973	2.63	---	19.07	----
1974	3.98	---	30.74	----
1975	4.72	---	18.23	----
1976	8.90	---	37.53	----
1977	13.66	---	49.88	----
1978	9.57	---	45.88	----
1979	7.82	---	36.66	----
1980	4.36	----	23.71	----
1981	1.32	----	44.38	----
1982	9.89	----	33.12	----
1983	4.87	----	24.84	----
1984	6.96	----	33.36	----
1985	10.13	40.30	33.71	-6.59
1986	15.00	50.00	43.96	-6.04
1987	9.38	32.90	40.00	+7.10
1988	7.20*	30.20	34.29	+4.09
1989	11.70	43.70	NA	NA

\* Modified index.

Table 5. Louisiana inshore brown shrimp catch 1989, in 1,000 pounds - Mississippi River to Texas. Does not include pieces.

Size Count	May	June	July	August	Total
<15	0.0	0.1	0.0	0.0	0.1
16-20	0.9	0.4	0.1	0.4	1.8
21-25	0.7	0.3	0.3	1.4	2.7
26-30	4.4	59.0	2.8	3.5	69.7
31-40	25.1	189.6	13.3	4.3	232.3
41-50	5.5	259.3	26.5	1.1	292.4
51-67	42.5	627.3	118.9	0.3	789.0
68-80	682.7	661.2	262.9	0.9	1607.7
81-100	608.8	866.1	214.7	1.3	1690.9
101-115	659.0	995.5	133.3	0.1	1787.9
>116	2432.8	2151.7	268.7	0.6	4853.8
Total	4462.4	5810.5	1041.5	13.9	11328.3

Table 6. Texas inshore brown shrimp catch 1989, in 1,000 pounds.

Size Count	May	June	July	August	Total
<15	0.0	0.0	0.0	0.0	0.0
16-20	0.1	0.3	0.6	0.0	1.0
21-25	0.6	0.0	1.7	0.6	2.9
26-30	0.6	0.1	9.5	2.0	12.2
31-40	2.1	5.8	56.4	28.2	92.5
41-50	7.5	12.6	37.3	32.9	90.3
51-67	11.8	15.3	108.5	58.9	194.5
68-80	33.1	37.6	222.0	71.7	364.4
81-100	146.9	174.4	198.9	77.4	597.6
101-115	483.4	394.1	202.3	31.7	1111.5
>116	1472.0	1602.1	531.6	13.5	3637.2
Total	2158.1	2260.3	1368.8	316.9	6104.1



Table 7. Mean number of shrimp per pound from inshore waters in 1989.

State	May	June	July	August
LA	119	102	96	46
TX	134	134	107	73

Table 8. Mean number of shrimp per pound from offshore waters in 1989.

State	May	June	July	August
LA	103	76	60	46
TX	57	75	42	37

Table 9. Numbers of shrimp caught in Texas and Louisiana from May-August 1989 (numbers in millions of shrimp).

State	May	June	July	August	Total
LA					
Inshore	531.8	590.3	100.3	0.6	1223.0
Offshore	688.1	474.7	291.7	119.6	1574.1
Total	1219.9	1065.0	392.0	120.2	2797.1
TX					
Inshore	288.8	303.9	146.1	23.1	761.9
Offshore	46.7	14.2	302.1	328.4	691.4
Total	335.5	318.1	448.2	351.5	1453.3

Table 10. May-August catch of brown shrimp in millions of pounds from inshore and offshore Louisiana waters in statistical subareas 13-17 and in Texas waters in statistical subareas 18-21.

Area	Years									
	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
Louisiana:										
Inshore	11.3	14.0	12.4	14.3	8.9	14.9	12.1	15.1	15.2	7.3
Offshore	20.5	14.9	20.8	22.8	16.9	13.6	8.8	13.7	23.1	11.7
Total	31.0	28.9	33.2	37.1	25.7	28.5	20.9	28.8	38.3	19.0
Texas:										
Inshore	6.1	6.9	7.6	5.1	5.4	7.1	5.9	4.1	4.2	4.5
Offshore	17.3	15.2	17.5	14.0	14.5	16.1	10.5	13.9	25.3	12.6
Total	23.4	22.1	25.1	19.1	19.9	23.5	16.4	18.0	29.5	17.1

Table 11. Estimated by-catch (lbs X 1000) of finfish off Texas during the Texas closure period from shrimp trawling activities. All estimates are per shrimp net.

Statistical Area	Historical		Current	
	200 Mile	15 Mile	200 Mile	15 Mile
18	681.7	2429.4	7563.8	8248.3
≤10fm	1255.4	558.1	7494.0	7639.2
>10fm	1174.0	123.6	69.8	709.0
19	3376.1	10671.9	2612.6	6199.7
≤10fm	3247.7	6870.4	2573.4	5438.6
>10fm	128.4	3801.5	39.2	761.1
20	353.9	2842.1	490.5	1406.8
≤10fm	108.8	114.3	327.9	344.5
>10fm	245.1	2727.8	162.6	1062.3
21	228.5	1635.1	383.5	1934.8
≤10fm	12.9	18.9	137.9	307.7
>10fm	215.6	1616.3	245.6	1627.0
Total	4640.2	17578.5	11050.4	17889.6
≤10fm	3927.5	8259.0	10533.2	13730.0
>10fm	712.7	9319.6	517.2	4159.4



Table 12. Estimated shrimp fleet by-catch (lbs X 1000) by species off Texas during the Texas closure period for historical and current catches.

Species	Historical		Current	
	<u>200 mile</u>	<u>15 mile</u>	<u>200 mile</u>	<u>15 mile</u>
<u>Cynoscion nothus</u> (silver seatrout)	1069.2	2436.4	1612.2	2580.7
<u>Micropogonias undulatus</u> (atlantic croaker)	601.2	1247.5	8695.5	16372.9
<u>Arius felis</u> (sea catfish)	401.0	831.9	172.6	477.7
<u>Leiostomus xanthurus</u> (spot)	280.6	581.5	795.1	1776.3
<u>Menticirrhus americanus</u> (southern kingfish)	200.1	415.7	215.8	450.6
<u>Trichiurus lepturus</u> (atlantic cutlass fish)	200.1	415.7	184.0	253.3
<u>Synodus foetens</u> (inshore lizardfish)	71.8	736.2	21.3	203.5
<u>Stenotomus caprinus</u> (longspine porgy)	74.2	765.8	79.8	608.5
<u>Syacium gunteri</u> (shoal flounder)	63.1	642.4	1.4	14.9
<u>Peprilus burti</u> (gulf butterflyfish)	49.8	505.2	243.7	858.1
<u>Centropristis philadelphica</u> (rock sea bass)	42.5	431.9	9.7	102.1
<u>Pristipomoides aquilonaris</u> (wenchman)	3.1	35.6	4.6	27.4
<u>Prionotus paralatus</u> (Mexican searobin)	1.7	17.6	3.3	22.8

Table 13. Percent of offshore Texas, Louisiana, Mississippi, Alabama and Florida landings caught off each state in 1989.

Percent of Texas Landings caught off each state offshore.

<u>State Caught</u>	<u>June 1-30</u>	<u>July 1-31</u>	<u>August 1-31</u>
TX	10.3	74.8	92.1
LA	89.0	25.2	7.9
MS	0.0	0.0	0.0
AL	0.0	0.0	0.0
FL	0.7	0.0	0.0
Thousand Pounds	2075.0	9251.1	8899.4

Percent of Louisiana landings caught off each state offshore.

<u>State Caught</u>	<u>June 1-30</u>	<u>July 1-31</u>	<u>August 1-31</u>
TX	0.0	14.0	13.5
LA	99.0	86.0	86.5
MS	1.0	0.0	0.1
AL	0.0	0.0	0.0
FL	0.0	0.0	0.0
Thousand Pounds	6126.0	3835.9	4255.5

Percent of Mississippi Landings caught off each state offshore.

<u>State Caught</u>	<u>June 1-30</u>	<u>July 1-31</u>	<u>August 1-31</u>
TX	0.0	0.0	0.0
LA	0.5	0.0	0.0
MS	99.5	99.0	100.0
AL	0.0	1.0	0.0
FL	0.0	0.0	0.0
Thousand Pounds	2696.9	832.8	686.8

Table 13 (cont'd).

Percent of Alabama landings caught off each state offshore.

<u>State Caught</u>	<u>June 1-30</u>	<u>July 1-31</u>	<u>August 1-31</u>
TX	0.0	20.5	37.7
LA	17.6	30.4	37.0
MS	82.1	45.4	25.0
AL	0.3	3.6	0.3
FL	0.0	0.0	0.0
Thousand Pounds	1094.6	715.9	1062.2

Percent of Florida landings caught off each state offshore.

<u>State Caught</u>	<u>June 1-30</u>	<u>July 1-31</u>	<u>August 1-31</u>
TX	0.0	1.9	18.0
LA	6.9	7.2	3.4
MS	1.8	5.7	3.8
AL	2.3	0.2	0.2
FL	89.0	85.0	74.5
Thousand Pounds	828.0	414.3	432.3



Table 14. Percent and total pounds landed in millions of pounds  
(offshore only) by vessels and boats from Gulf States  
from June through August 1989.

Home Port	Area Landed	Area Fished	Pounds Landed June 1-30	Landings in States	Total % of Total Pounds
LA	LA	LA	1.70	5.25	32.4
TX	LA	LA	0.39	5.25	7.5
Other*	LA	LA	0.06	5.25	1.2
Unknown**	LA	LA	3.10	5.25	58.9
LA	LA	TX	0.00	5.25	0.0
TX	LA	TX	0.00	5.25	0.0
Other	LA	TX	0.00	5.25	0.0
Unknown	LA	TX	0.00	5.25	0.0
LA	TX	LA	0.04	2.06	2.1
TX	TX	LA	1.55	2.06	75.1
Other	TX	LA	0.09	2.06	4.4
Unknown	TX	LA	0.17	2.06	8.1
LA	TX	TX	0.00	2.06	0.0
TX	TX	TX	0.19	2.06	9.3
Other	TX	TX	0.00	2.06	0.0
Unknown	TX	TX	0.02	2.06	0.9
July 1-31					
LA	LA	LA	1.31	3.82	34.3
TX	LA	LA	0.14	3.82	3.6
Other	LA	LA	0.04	3.82	1.1
Unknown	LA	LA	1.79	3.82	46.9
LA	LA	TX	0.11	3.82	2.8
TX	LA	TX	0.03	3.82	0.7
Other	LA	TX	0.00	3.82	0.1
Unknown	LA	TX	0.40	3.82	10.5
LA	TX	LA	0.03	9.25	0.3
TX	TX	LA	1.96	9.25	21.2
Other	TX	LA	0.17	9.25	1.8
Unknown	TX	LA	0.17	9.25	1.8
LA	TX	TX	0.21	9.25	2.3
TX	TX	TX	5.09	9.25	55.0
Other	TX	TX	0.79	9.25	8.5
Unknown	TX	TX	0.83	9.25	9.0

Table 14.

Cont'd. Percent and total pounds landed in millions of pounds (offshore only) by vessels and boats from Gulf States from June through August 1989.

Home Port	Area Landed	Area Fished	Pounds Landed August 1-31	Landings in States	Total % of Total Pounds
LA	LA	LA	1.50	4.24	35.4
TX	LA	LA	0.09	4.24	2.1
Other	LA	LA	0.02	4.24	0.5
Unknown	LA	LA	2.06	4.24	48.5
LA	LA	TX	0.10	4.24	2.2
TX	LA	TX	0.01	4.24	0.2
Other	LA	TX	0.02	4.24	0.4
Unknown	LA	TX	0.46	4.24	10.7
LA	TX	LA	0.01	8.90	0.1
TX	TX	LA	0.56	8.90	6.3
Other	TX	LA	0.04	8.90	0.4
Unknown	TX	LA	0.10	8.90	1.1
LA	TX	TX	0.16	8.90	1.8
TX	TX	TX	6.69	8.90	75.2
Other	TX	TX	0.62	8.90	7.0
Unknown	TX	TX	0.72	8.90	8.1

\* Home port vessels from other states (i.e., Florida, Mississippi and Alabama).

\*\* Unknown consolidated vessels and boats; mostly uninterviewed vessels and boats from the home port of the area fished.

Table 15. Summary of fishing effort and CPUE for Louisiana (13-17) and Texas (18-21).

Fishing Effort (1000 Day)						
Year	Areas 13-17			Areas 18-21		
	May-June	July	August	May-June	July	August
1981	14.8	8.1	3.8	1.1	4.4	10.4
1982	14.2	6.4	3.4	2.6	5.2	10.2
1983	9.1	4.2	4.9	2.3	3.7	6.7
1984	9.8	6.4	4.7	2.4	8.2	9.0
1985	11.1	6.0	3.7	1.5	6.8	8.4
1986	15.9	7.5	4.3	6.3	6.3	6.2
1987	19.0	10.0	5.8	7.7	9.8	8.2
1988	18.8	7.5	8.0	7.1	9.6	8.7
1989	28.5	8.2	2.8	3.8	5.7	10.2
Average						
(81-85)	11.8	6.2	4.1	2.0	5.7	8.9
(86-88)	17.9	8.3	6.0	7.0	8.6	7.7

CPUE (lbs/fishing day)						
Year	Areas 13-17			Areas 18-21		
	May-June	July	August	May-June	July	August
1981	852	927	799	308	2,382	1,408
1982	607	525	522	295	1,279	629
1983	430	415	470	310	1,414	714
1984	718	598	573	295	1,074	723
1985	982	612	682	389	1,223	672
1986	830	840	773	524	896	799
1987	605	595	577	429	905	653
1988	351	556	521	538	781	578
1989	454	603	832	273	1,276	889
Average						
(81-85)	731	673	600	333	1,385	848
(86-88)	583	660	597	441	857	662



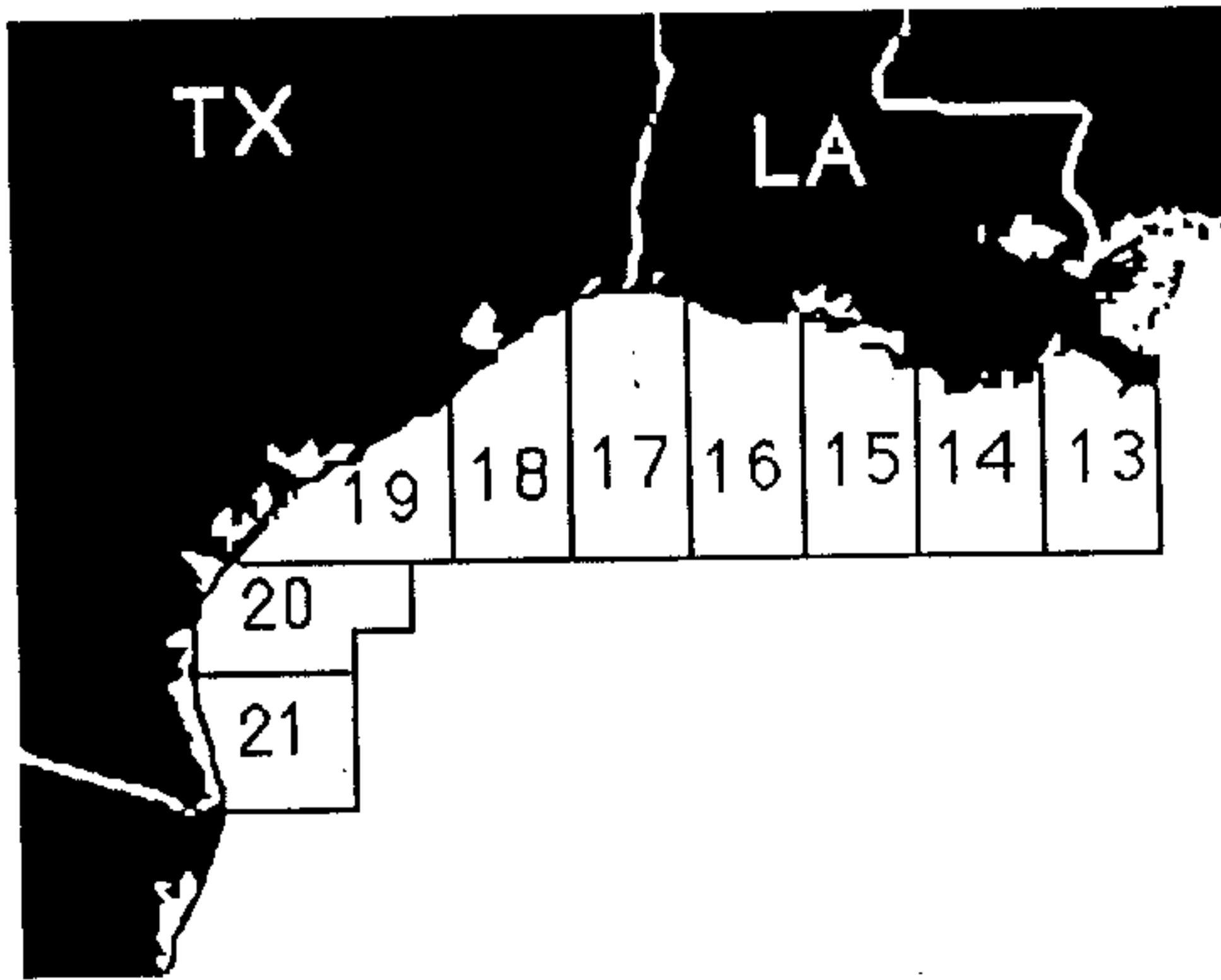


Figure 1. Location of statistical subareas off the Louisiana and Texas coasts.

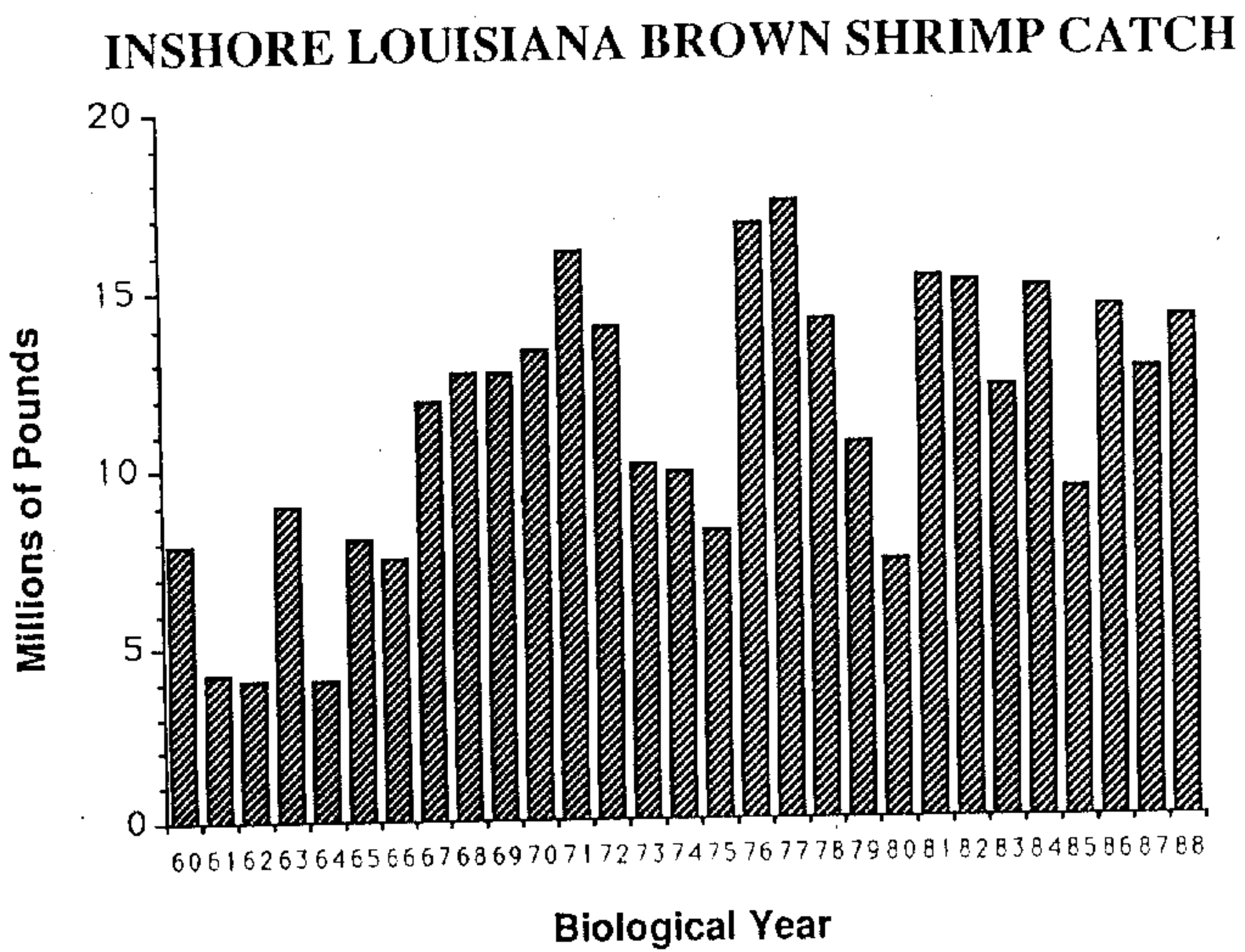


Figure 2. Annual inshore brown shrimp catch from Louisiana west of the Mississippi River.

OFFSHORE LOUISIANA BROWN SHRIMP CATCH

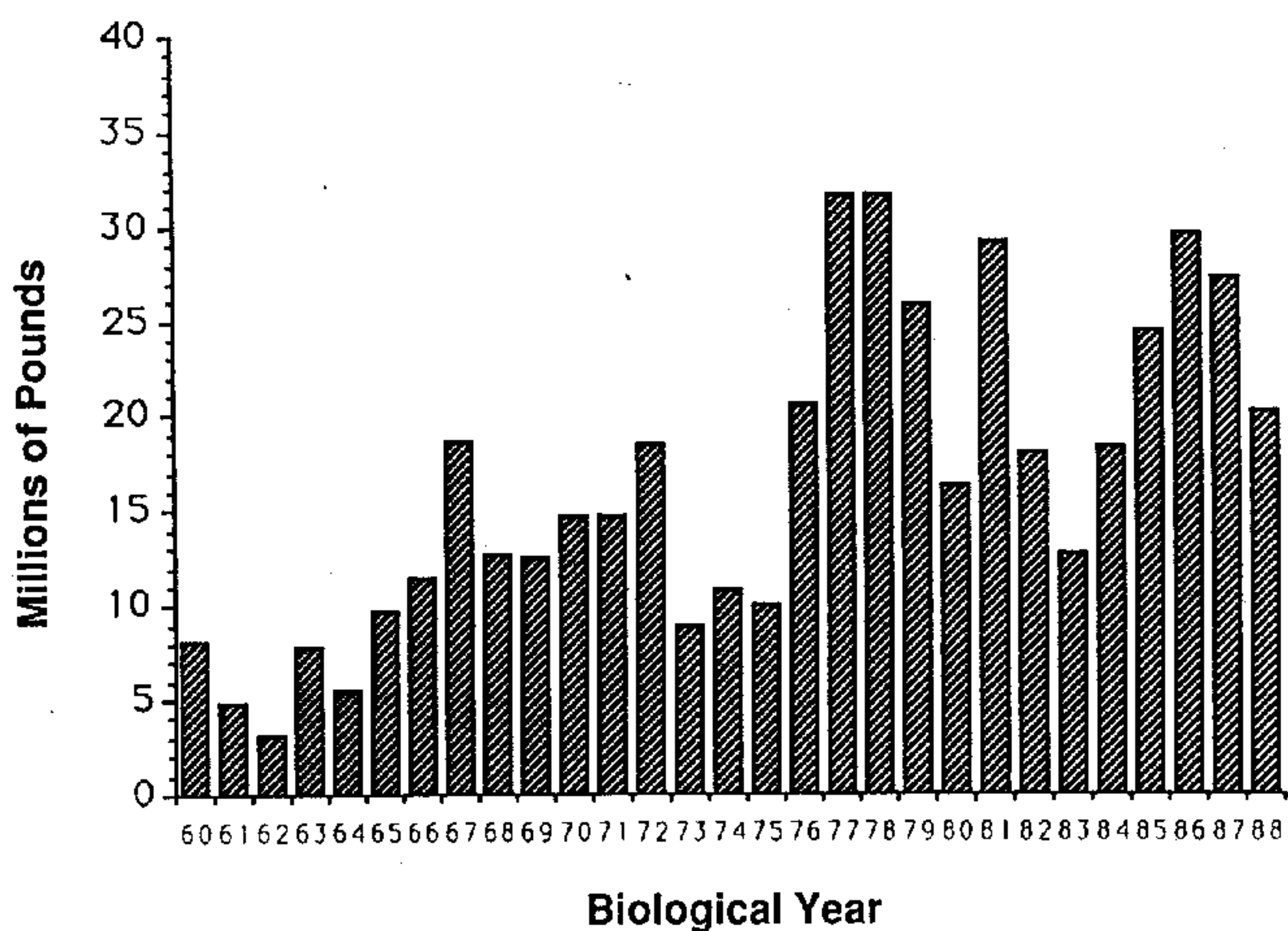


Figure 3. Annual offshore brown shrimp catch from Louisiana west of the Mississippi River.

BROWN SRHIMP CATCH OFF LOUISIANA

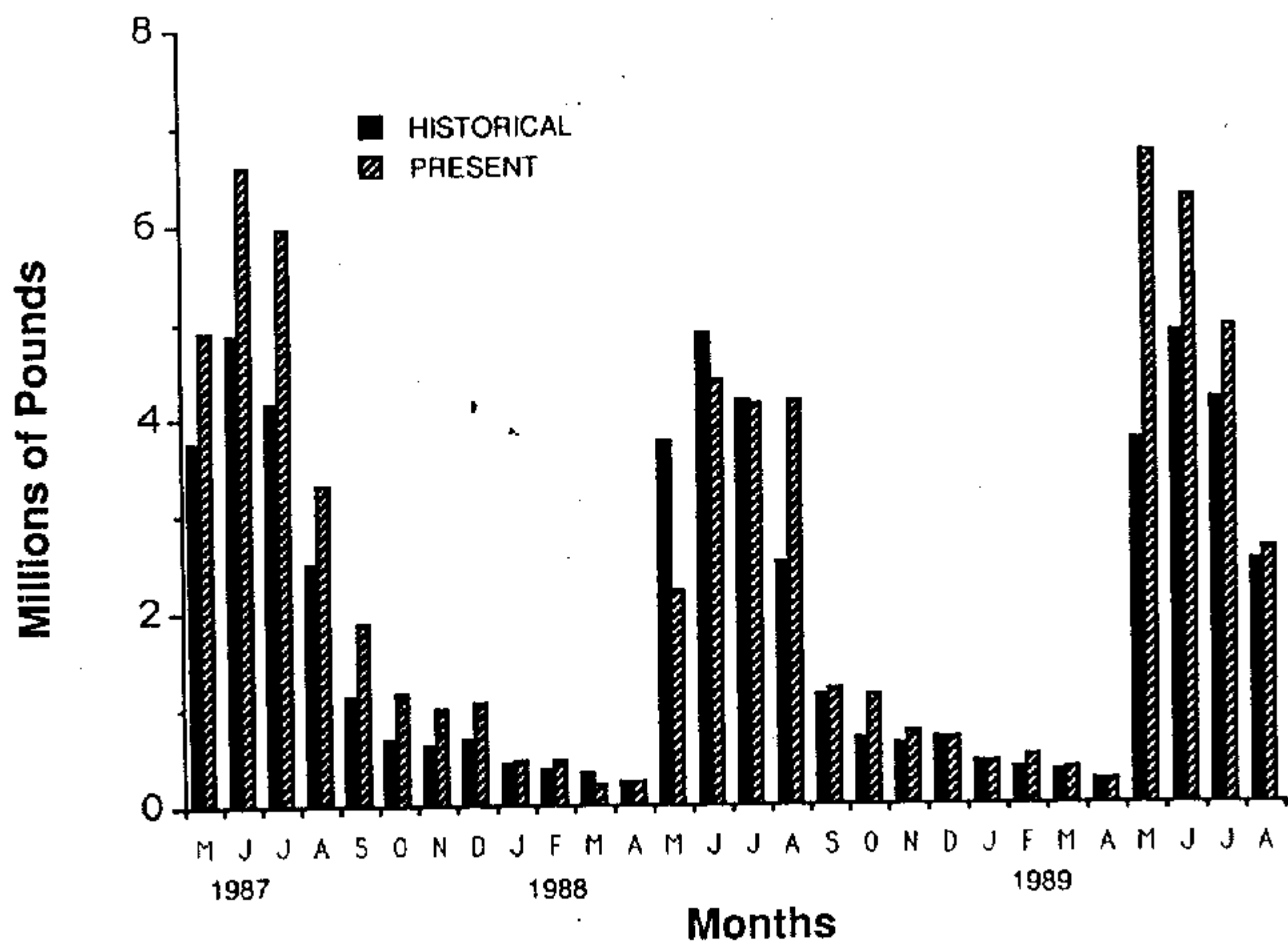


Figure 4. Average monthly historical catch compared to monthly catch values during biological years 1987, 1988 and the first four months of biological year 1989.

BROWN SHRIMP EFFORT OFF LOUISIANA

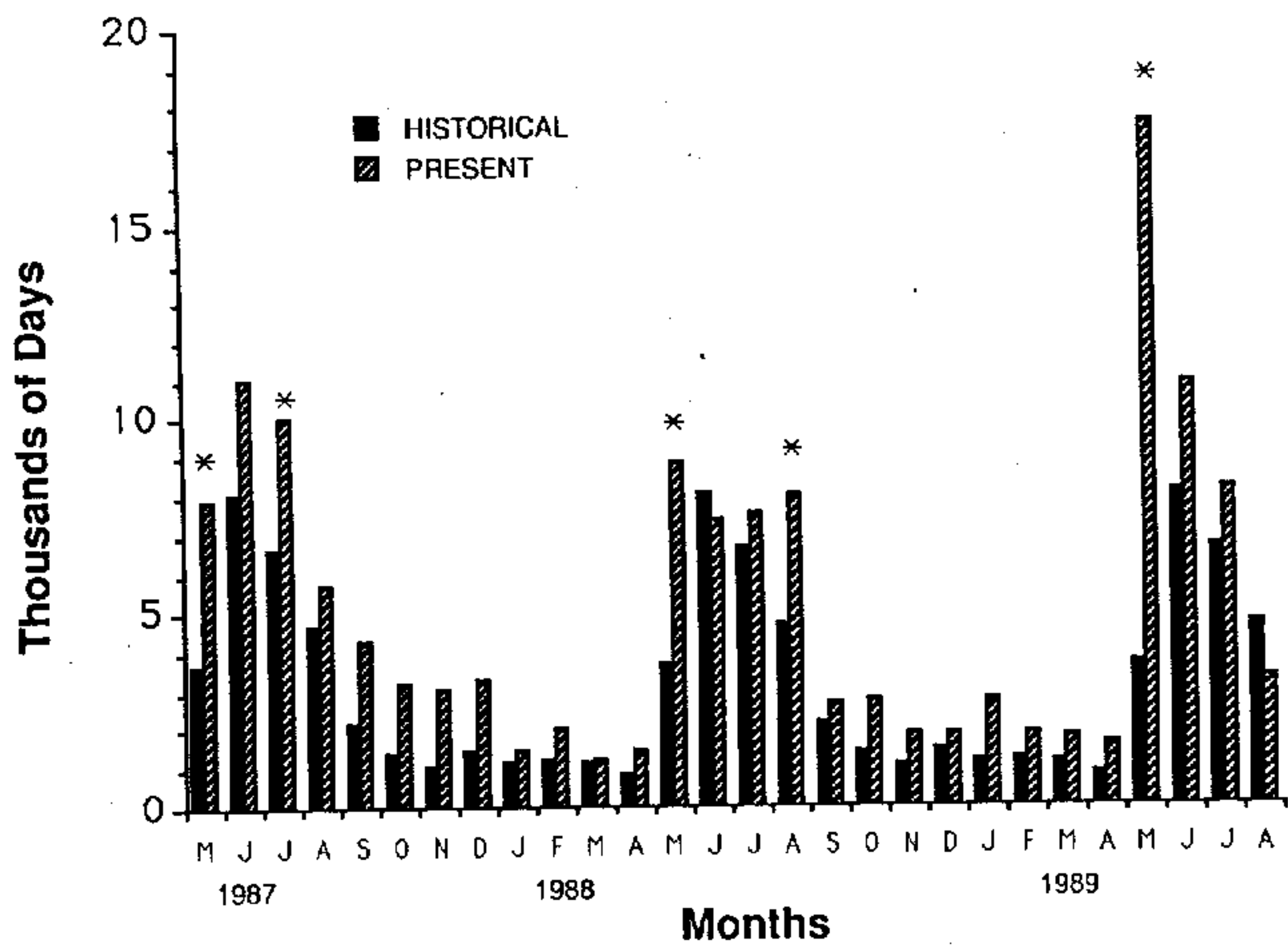


Figure 5. Average monthly historical effort compared to monthly effort values during biological years 1987, 1988 and the first four months of biological year 1989.

BROWN SHRIMP CPUE OFF LOUISIANA

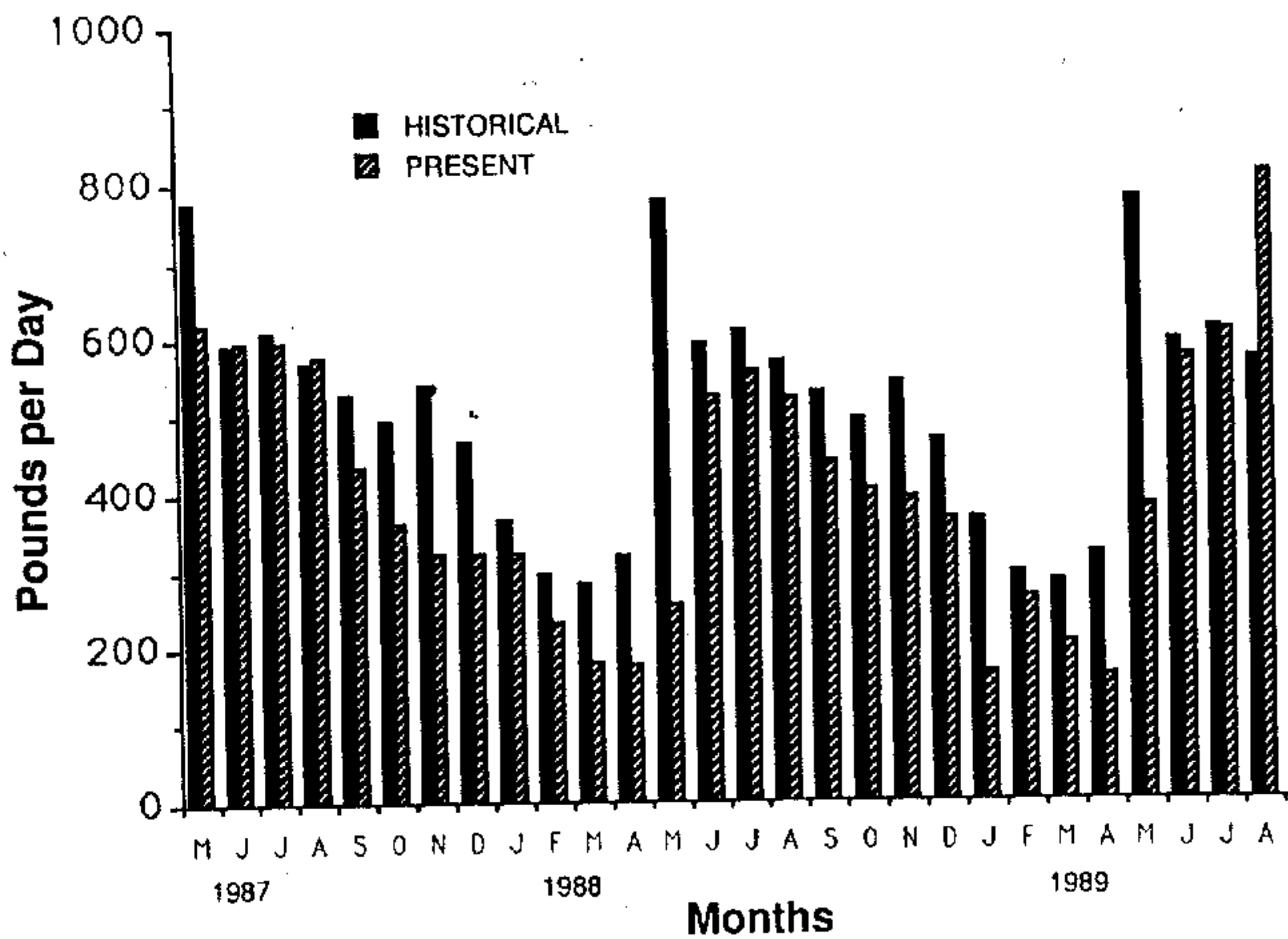


Figure 6. Average monthly historical CPUE compared to monthly CPUE values during biological years 1987, 1988 and the first four months of biological year 1989.



## INSHORE TEXAS BROWN SHRIMP CATCH

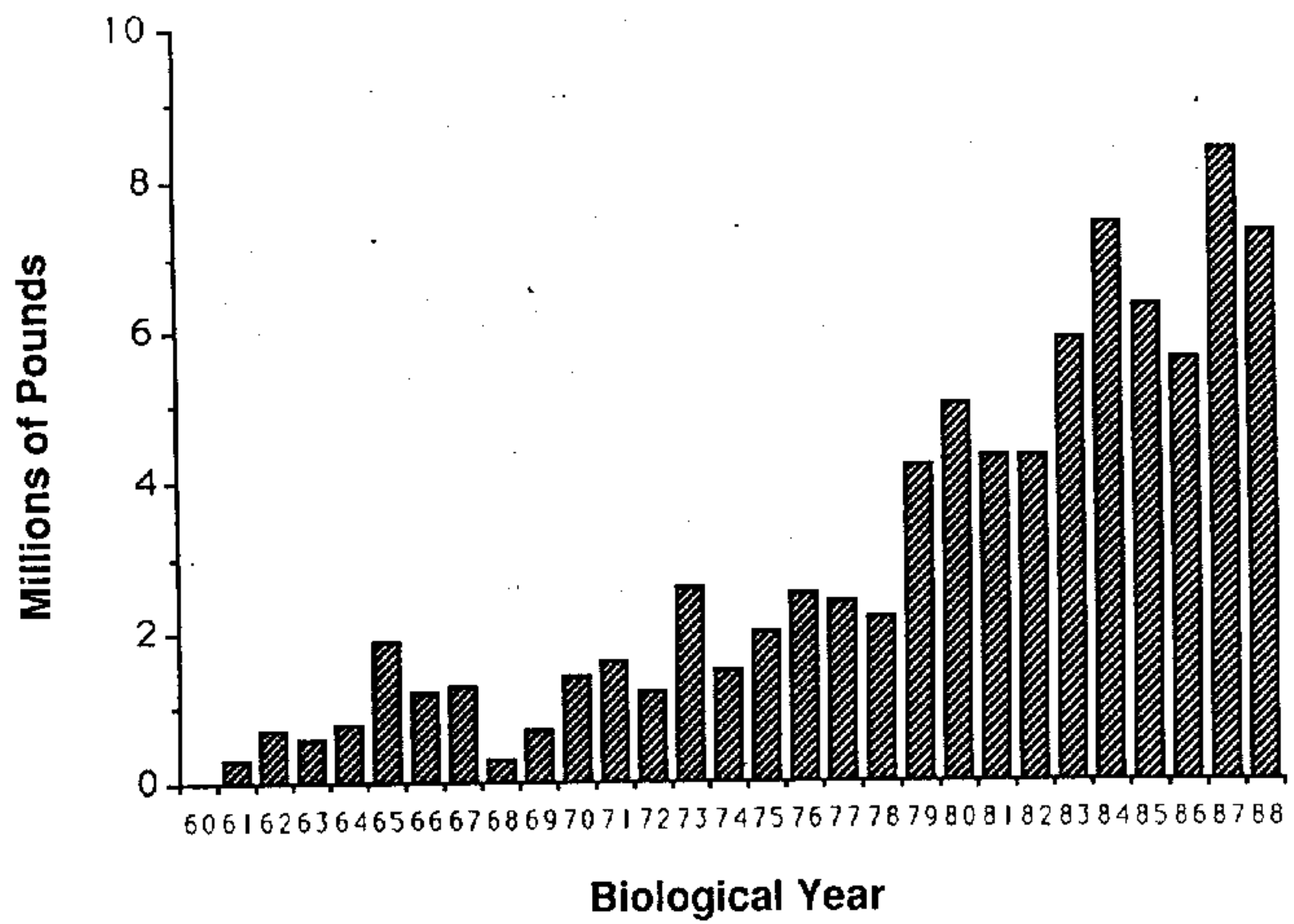


Figure 7. Annual inshore brown shrimp catch from Texas.

## OFFSHORE TEXAS BROWN SHRIMP CATCH

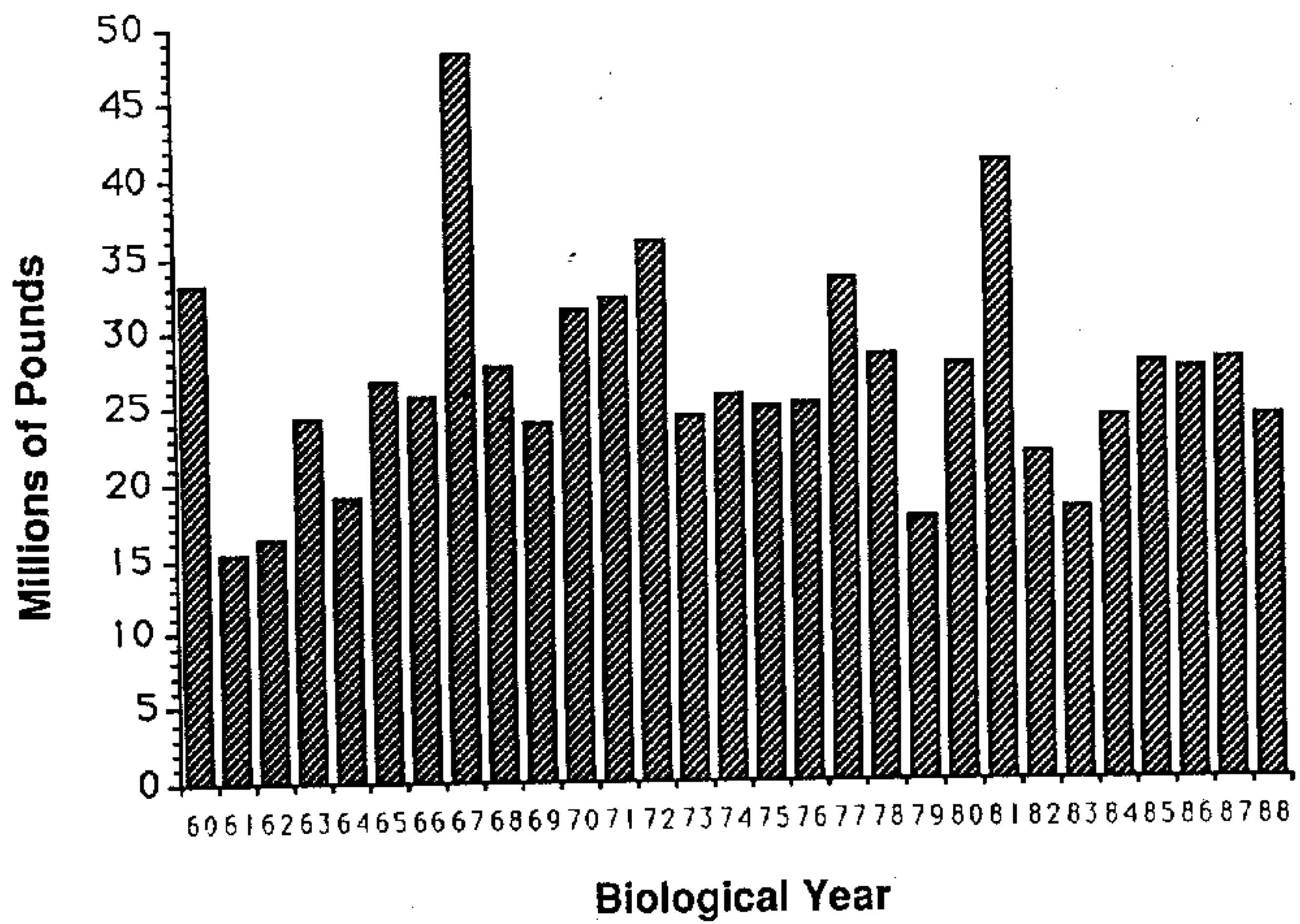


Figure 8. Annual offshore brown shrimp catch from Texas.

## BROWN SHRIMP CATCH OFF TEXAS

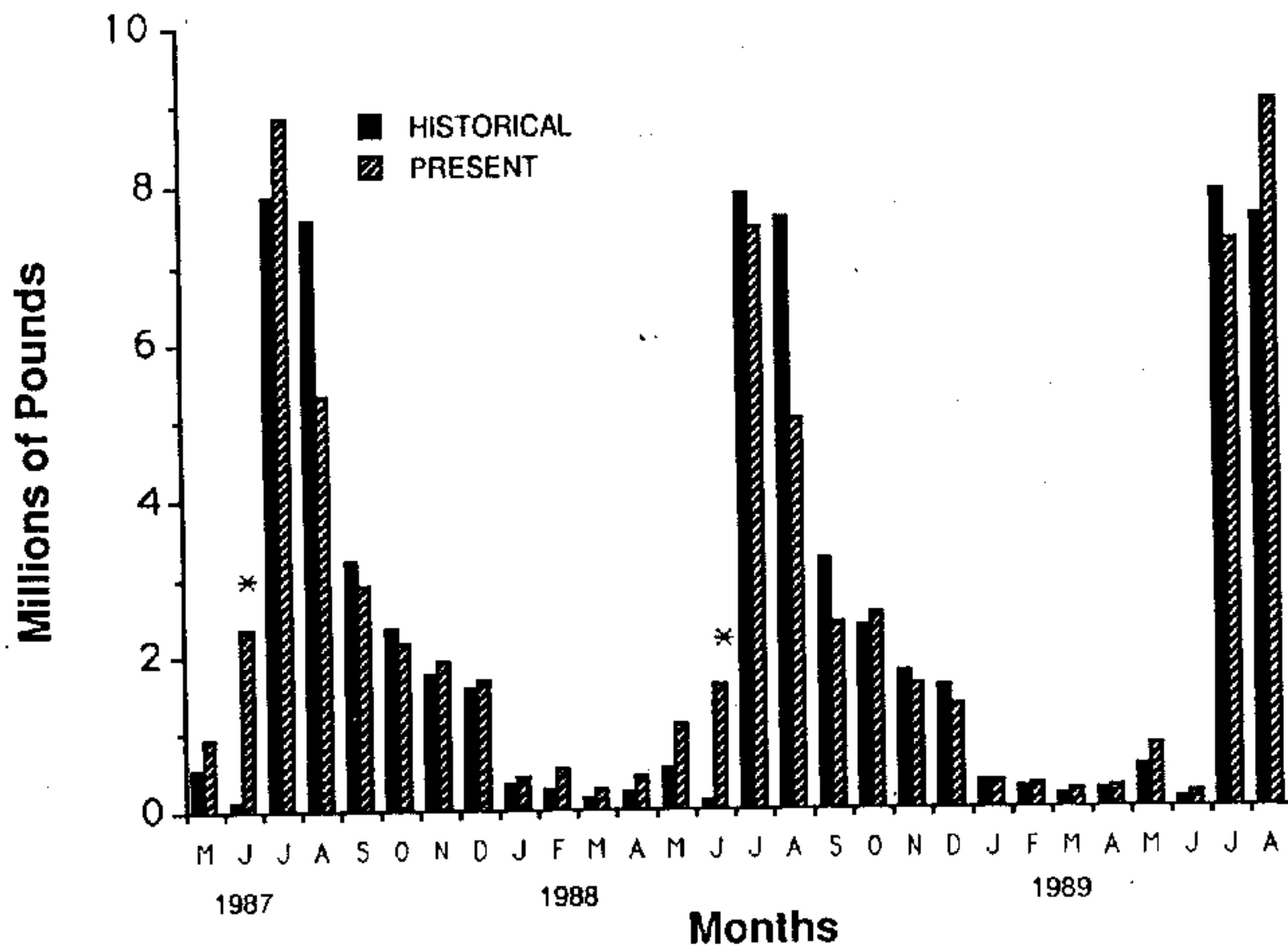


Figure 9. Average monthly historical catch compared to monthly catch values during biological years 1987, 1988 and the first four months of biological year 1989.

## BROWN SHRIMP EFFORT OFF TEXAS

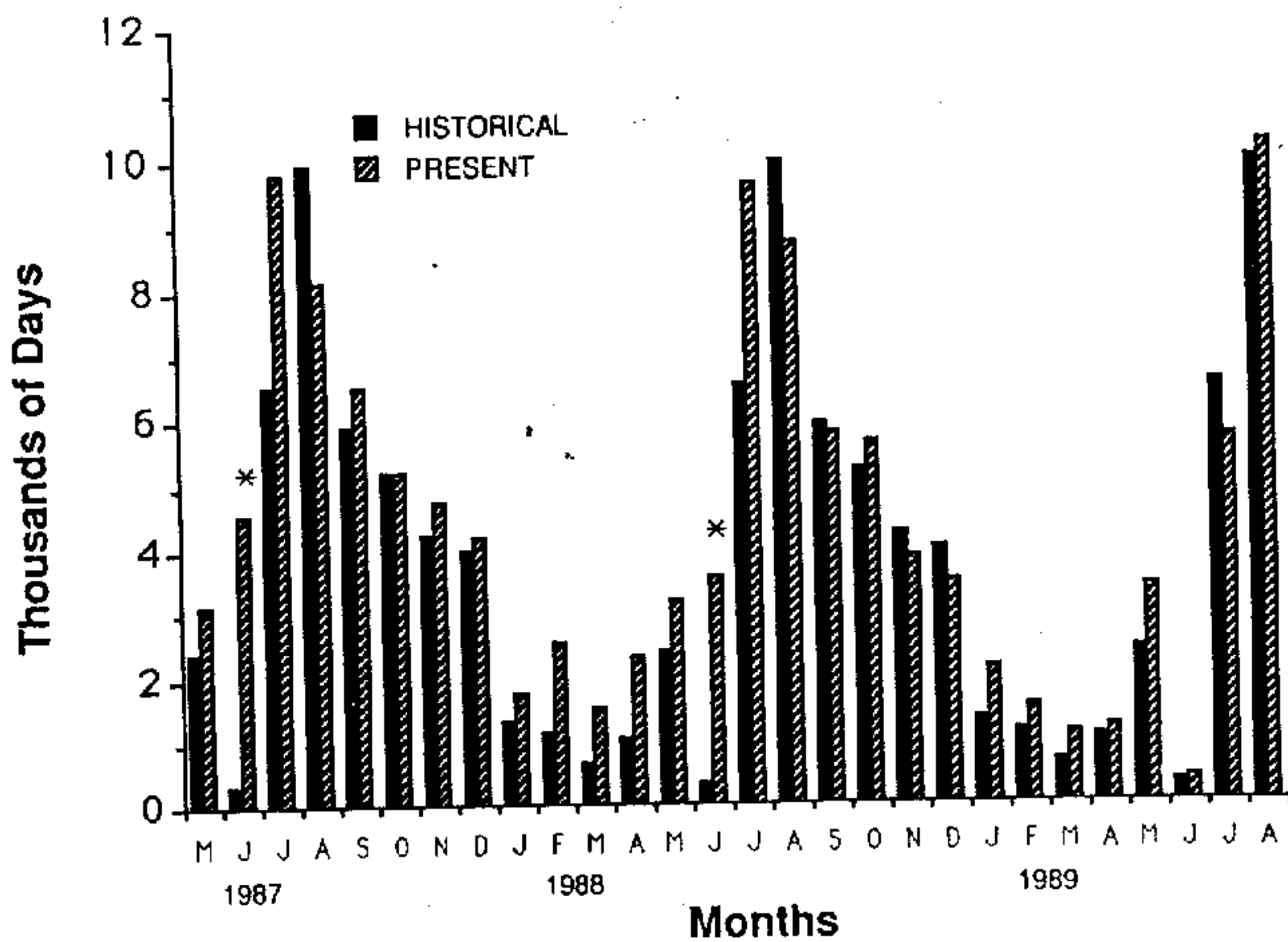


Figure 10. Average monthly historical effort compared to monthly effort values during biological years 1987, 1988 and the first four months of biological year 1989.

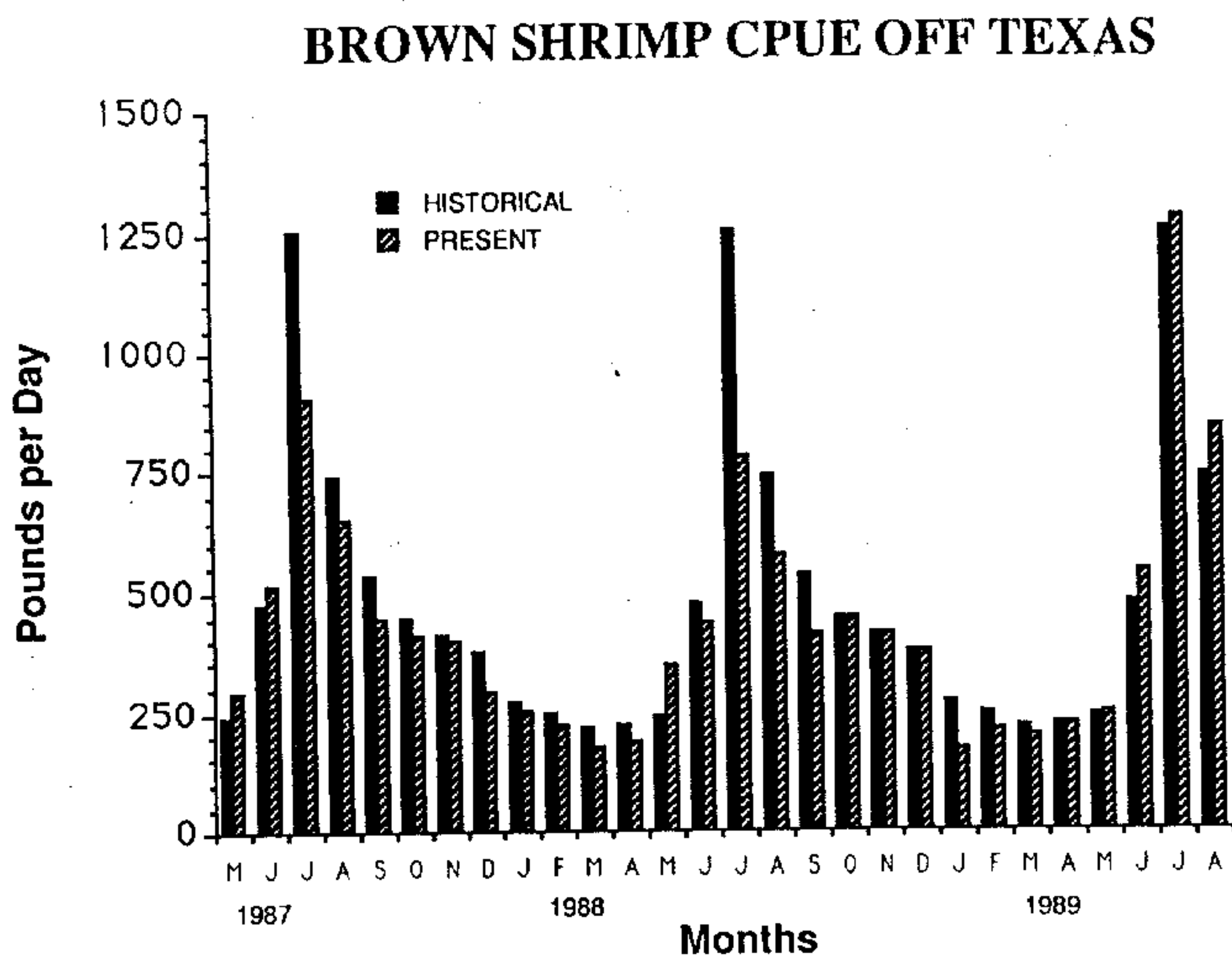


Figure 11. Average monthly historical CPUE compared to monthly CPUE values during biological years 1987, 1988 and the first four months of biological year 1989.

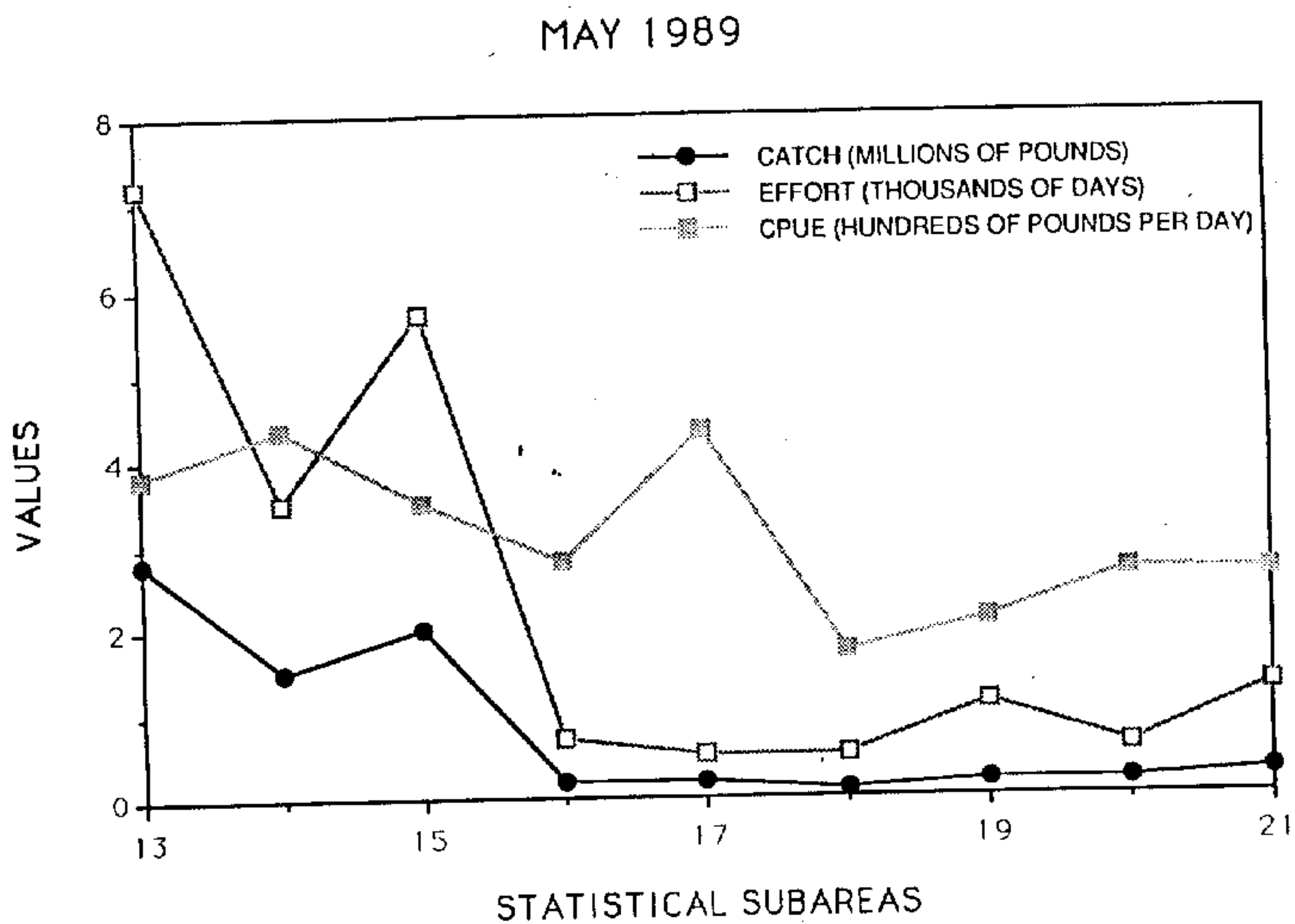


Figure 12a. Offshore brown shrimp catch, fishing effort and CPUE from statistical subareas 13-21.



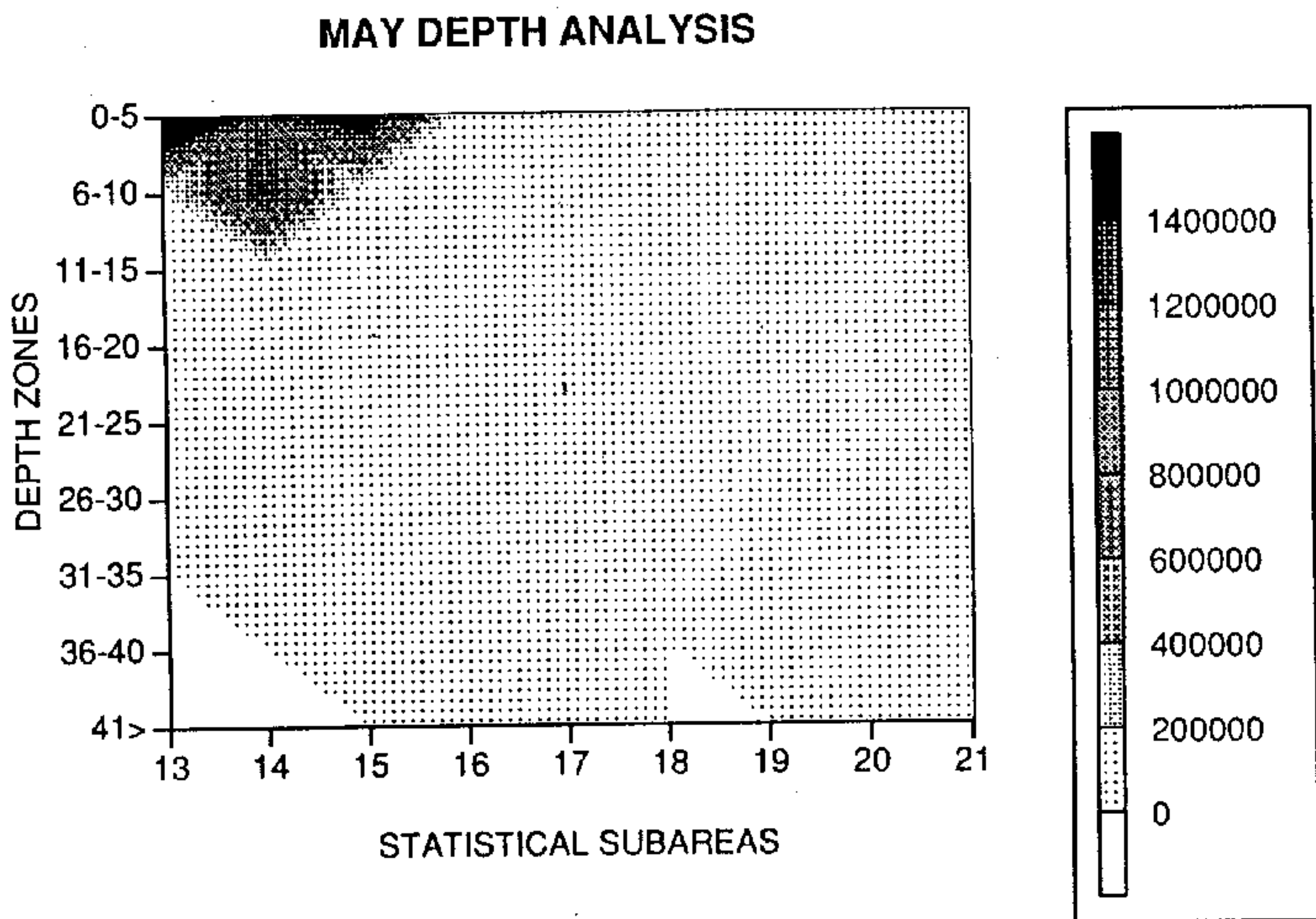


Figure 12b. Pounds of brown shrimp catch from statistical subareas 13-21 by depth zones.

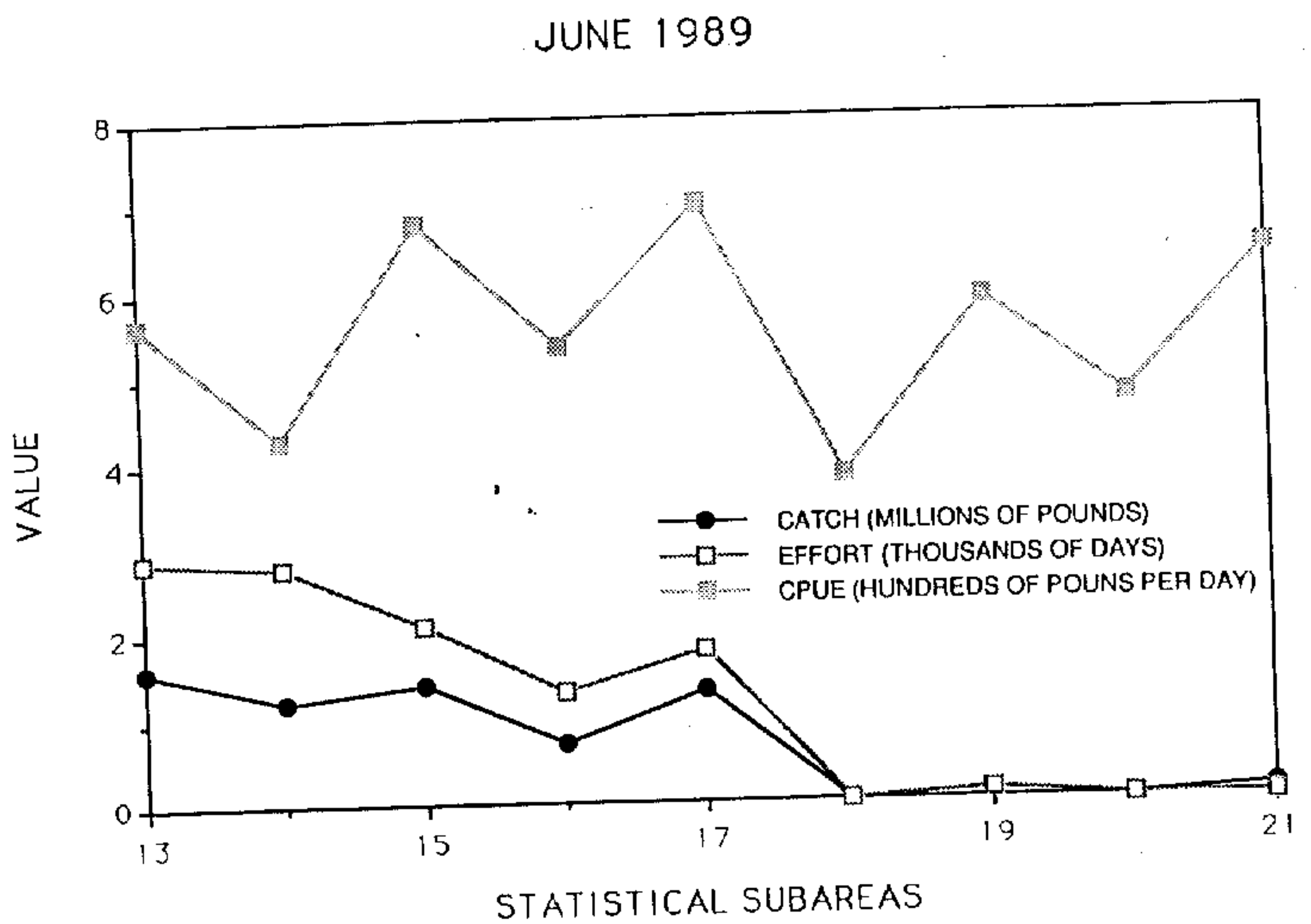


Figure 13a. Offshore brown shrimp catch, fishing effort and CPUE from statistical subareas 13-21.

## JUNE DEPTH ANALYSIS

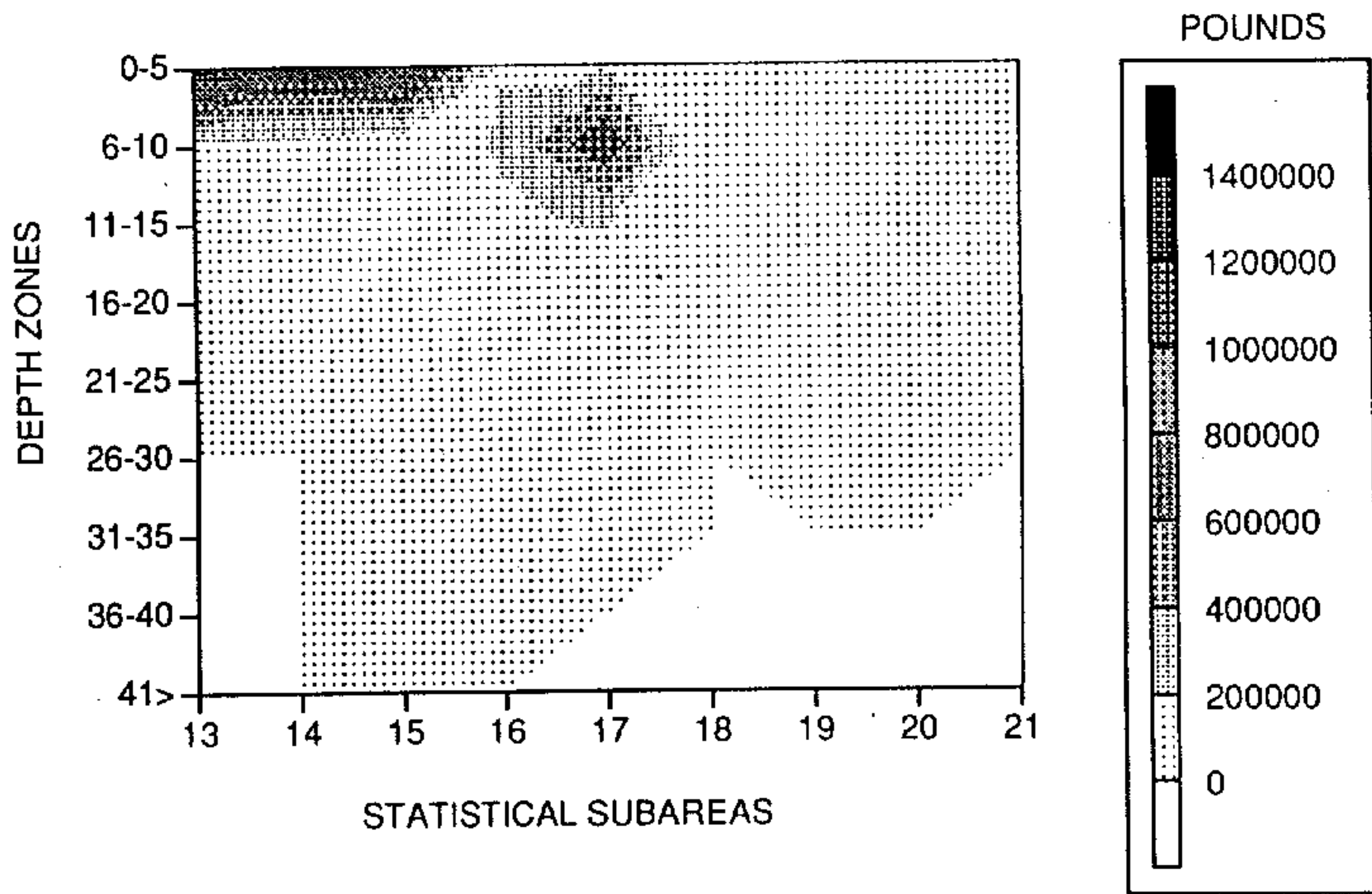


Figure 13b. Pounds of brown shrimp catch from statistical subareas 13-21 by depth zones.

## JULY 1989

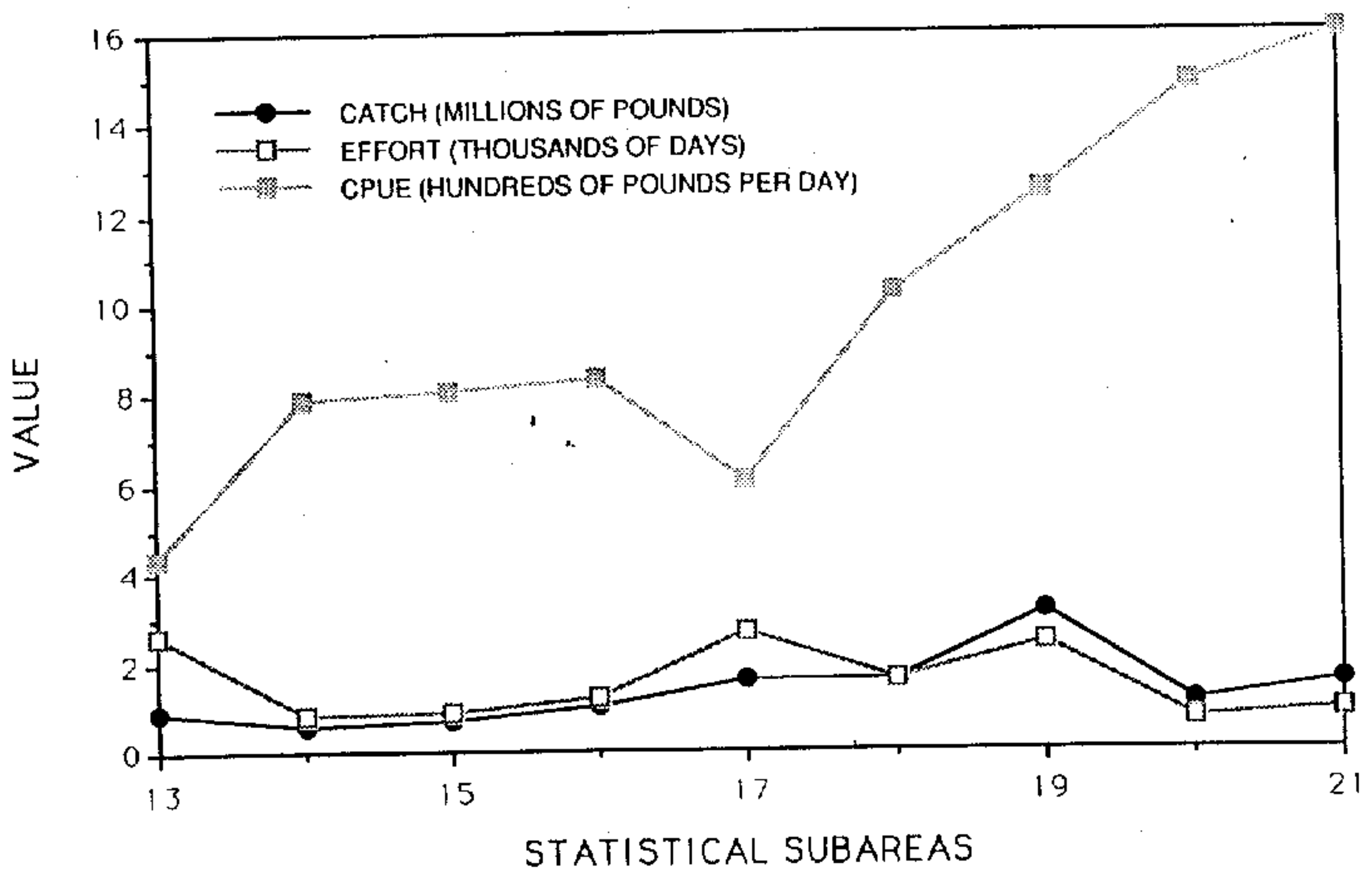


Figure 14a. Offshore brown shrimp catch, fishing effort and CPUE from statistical subareas 13-21.

## JULY DEPTH ANALYSIS

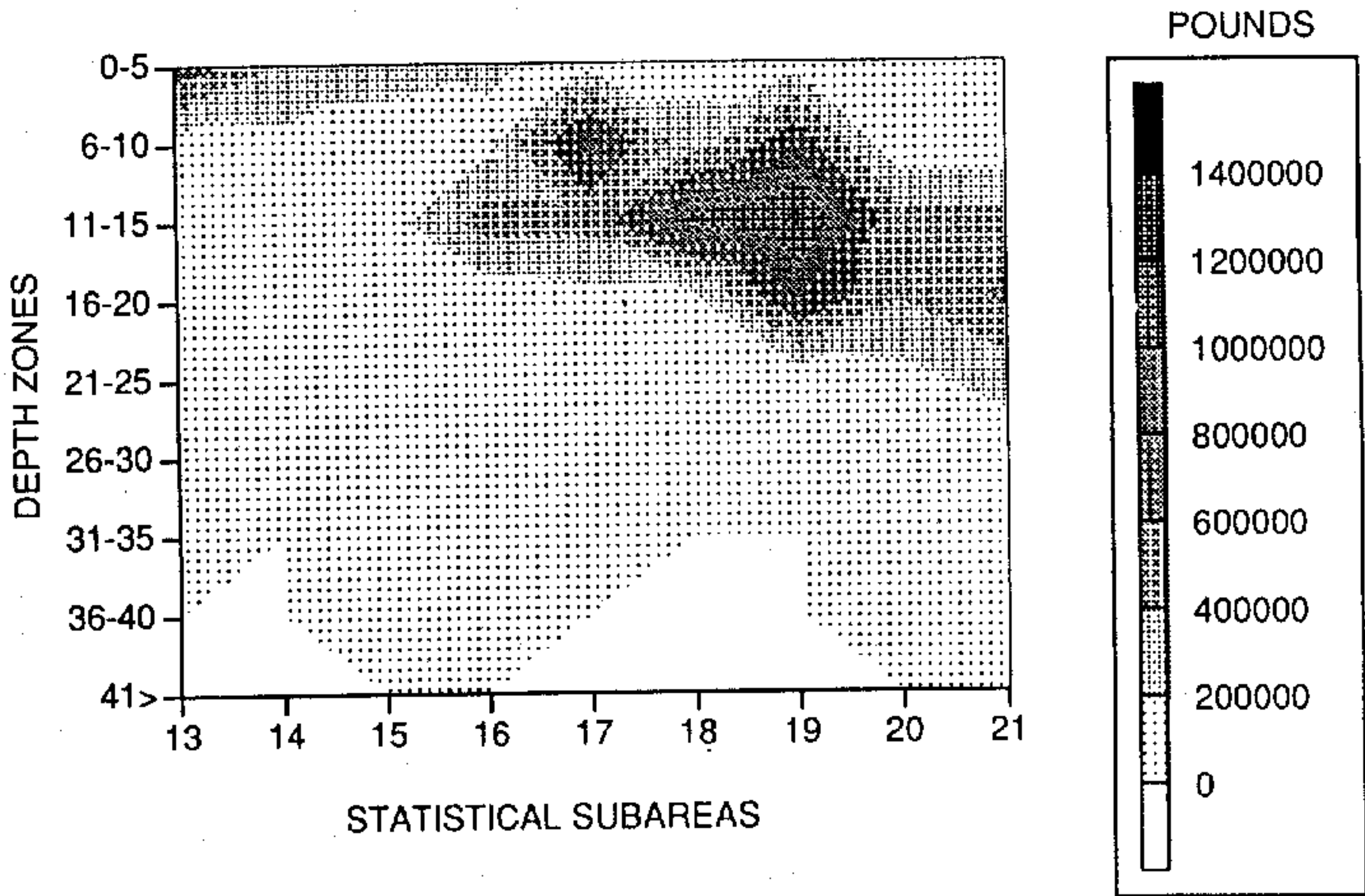


Figure 14b. Pounds of brown shrimp catch from statistical subareas 13-21 by depth zones.

## AUGUST 1989

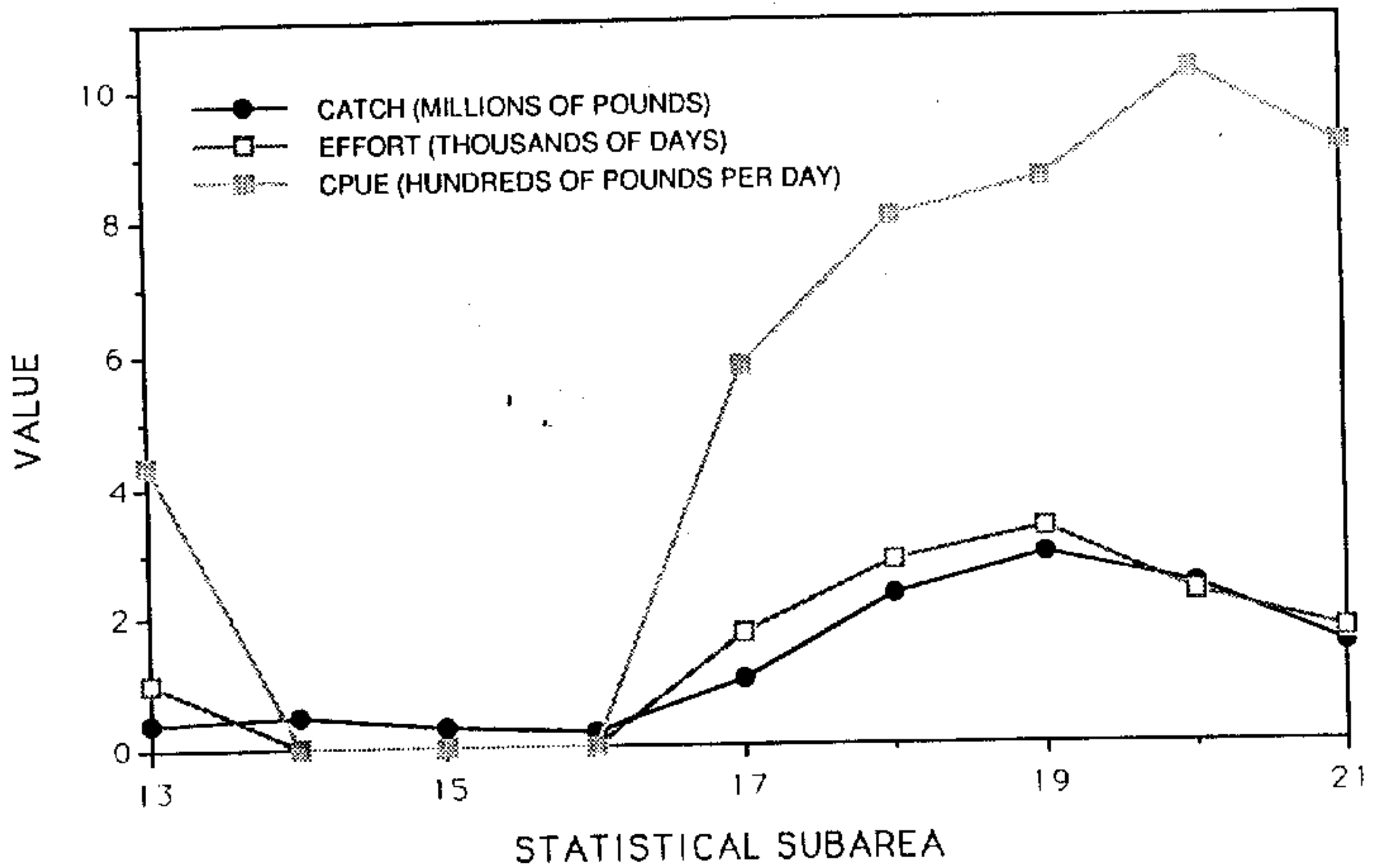


Figure 15a. Offshore brown shrimp catch, fishing effort and CPUE from statistical subareas 13-21.



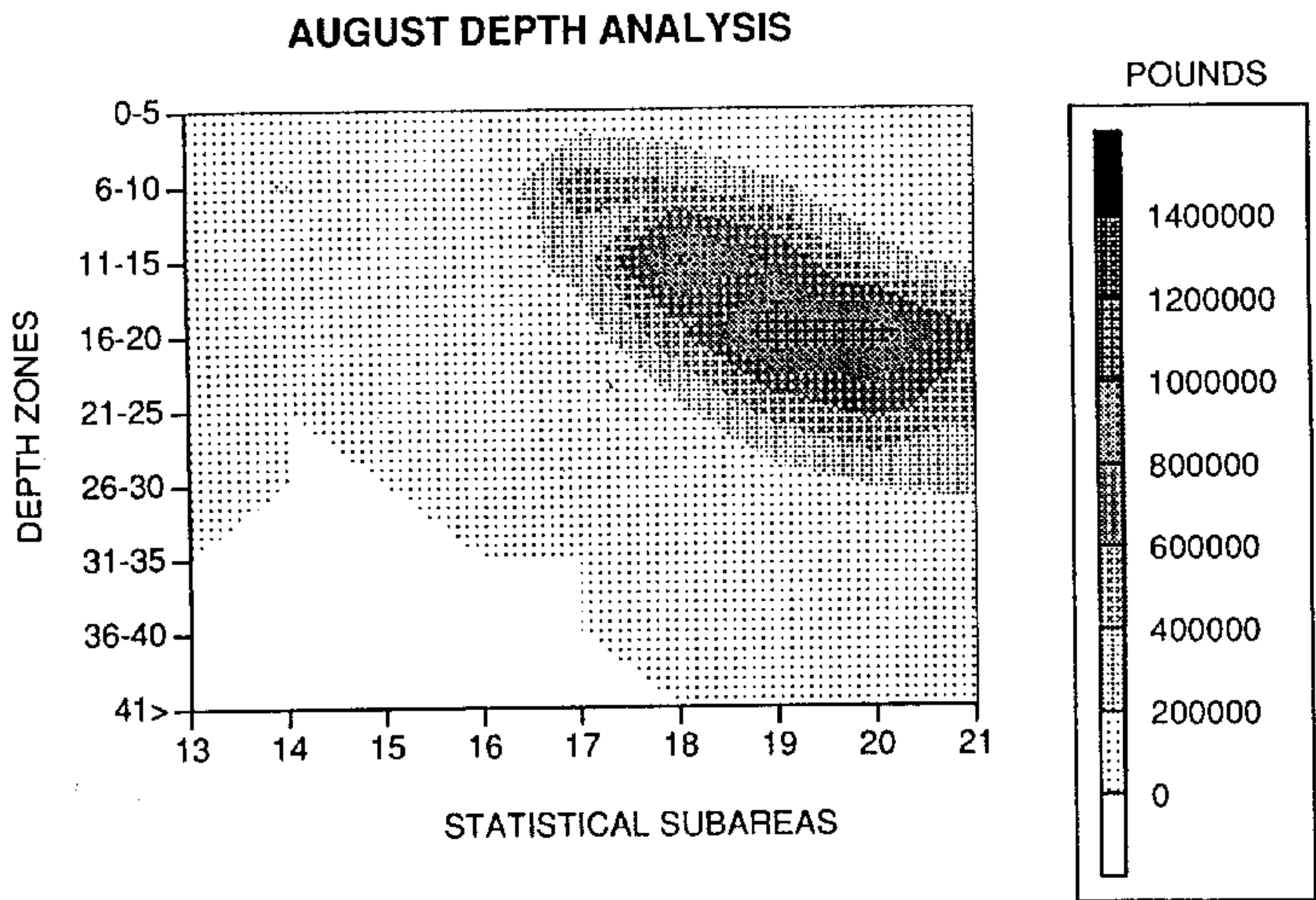


Figure 15b. Pounds of brown shrimp catch from statistical subareas 13-21 by depth zones.

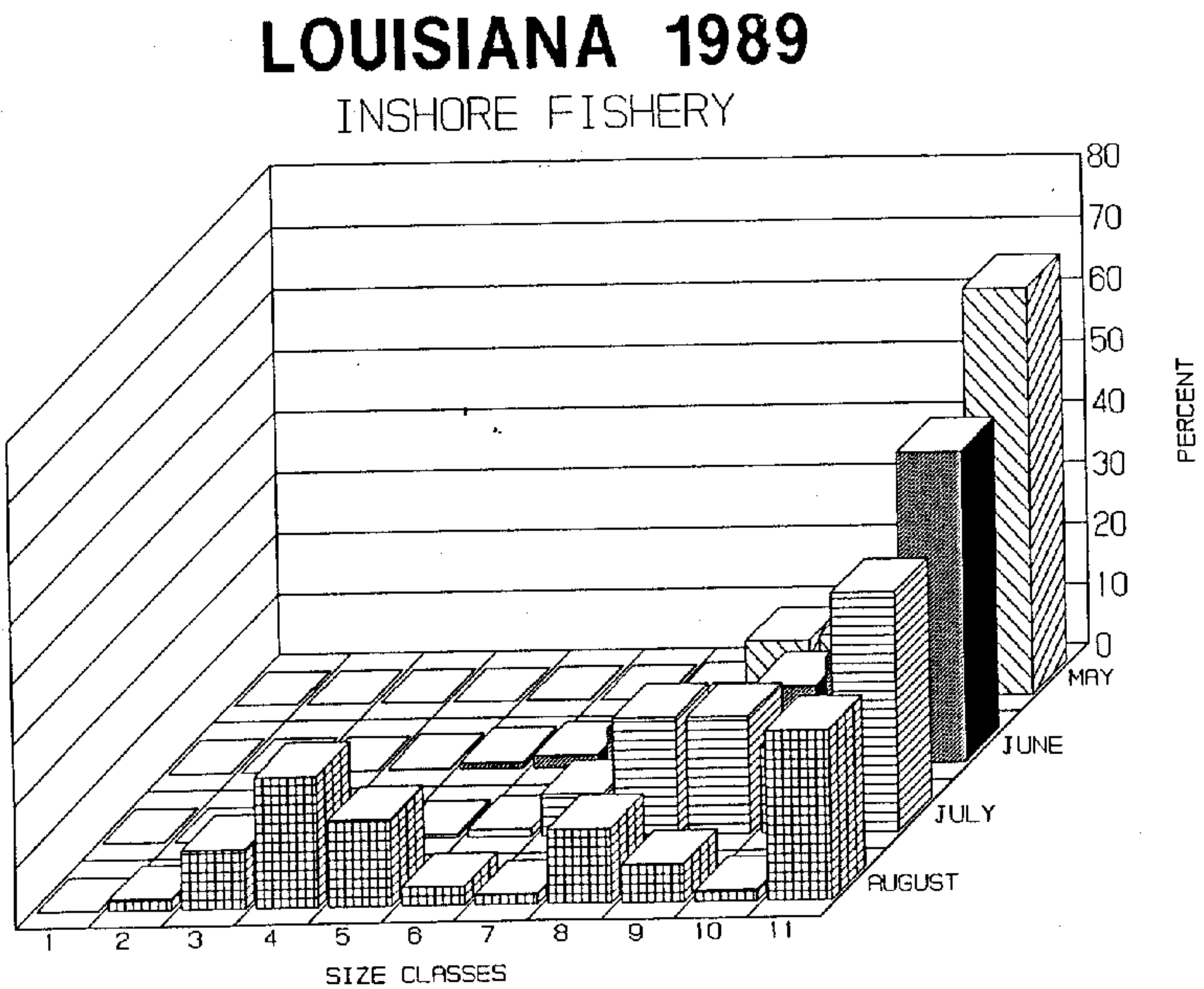


Figure 16. Size distribution of brown shrimp from inshore Louisiana during the May-August 1989 period.

# TEXAS 1989

## INSHORE FISHERY

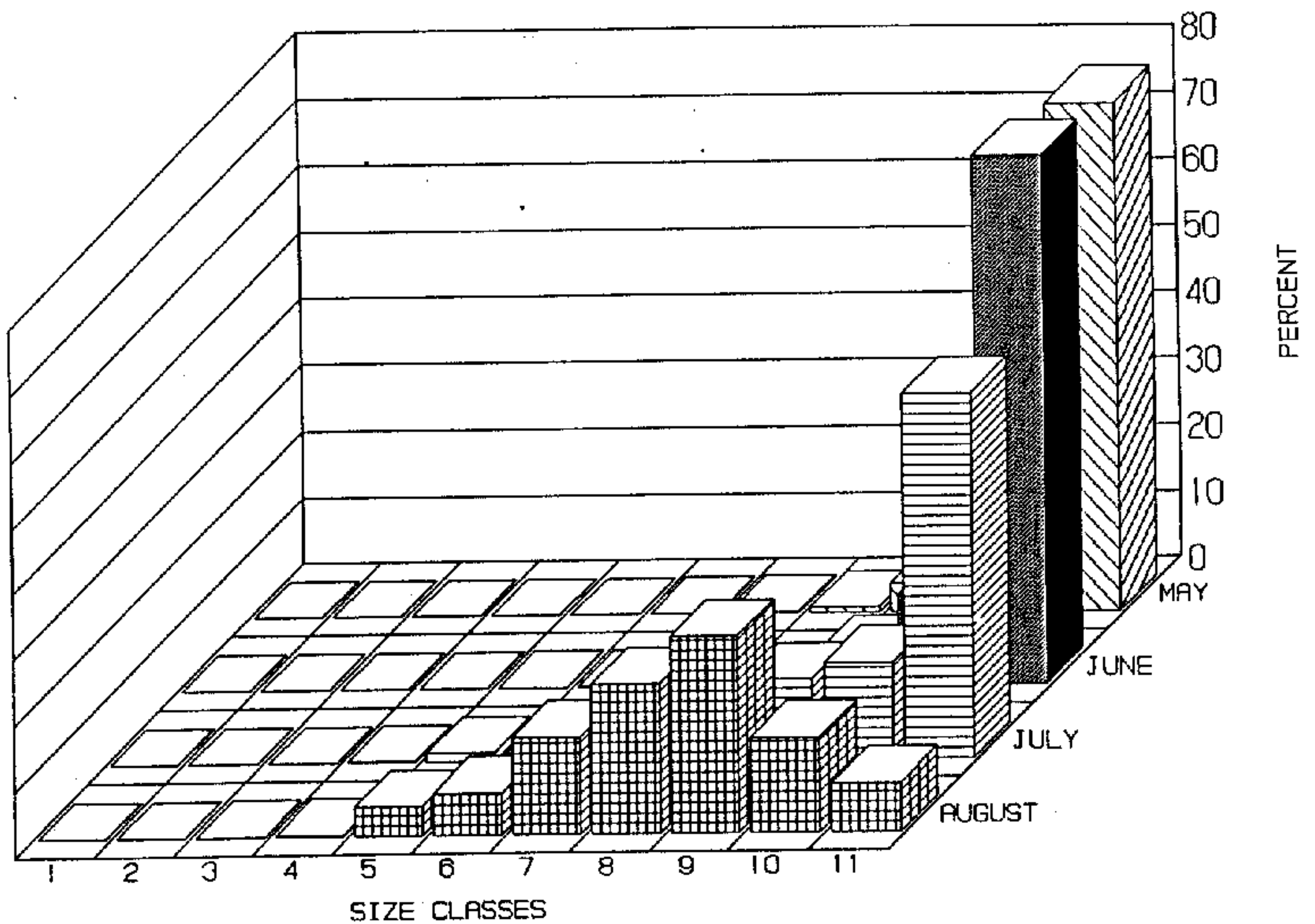


Figure 17. Size distribution of brown shrimp from inshore Texas during the May-August 1989 period.

# LOUISIANA 1989

## OFFSHORE FISHERY

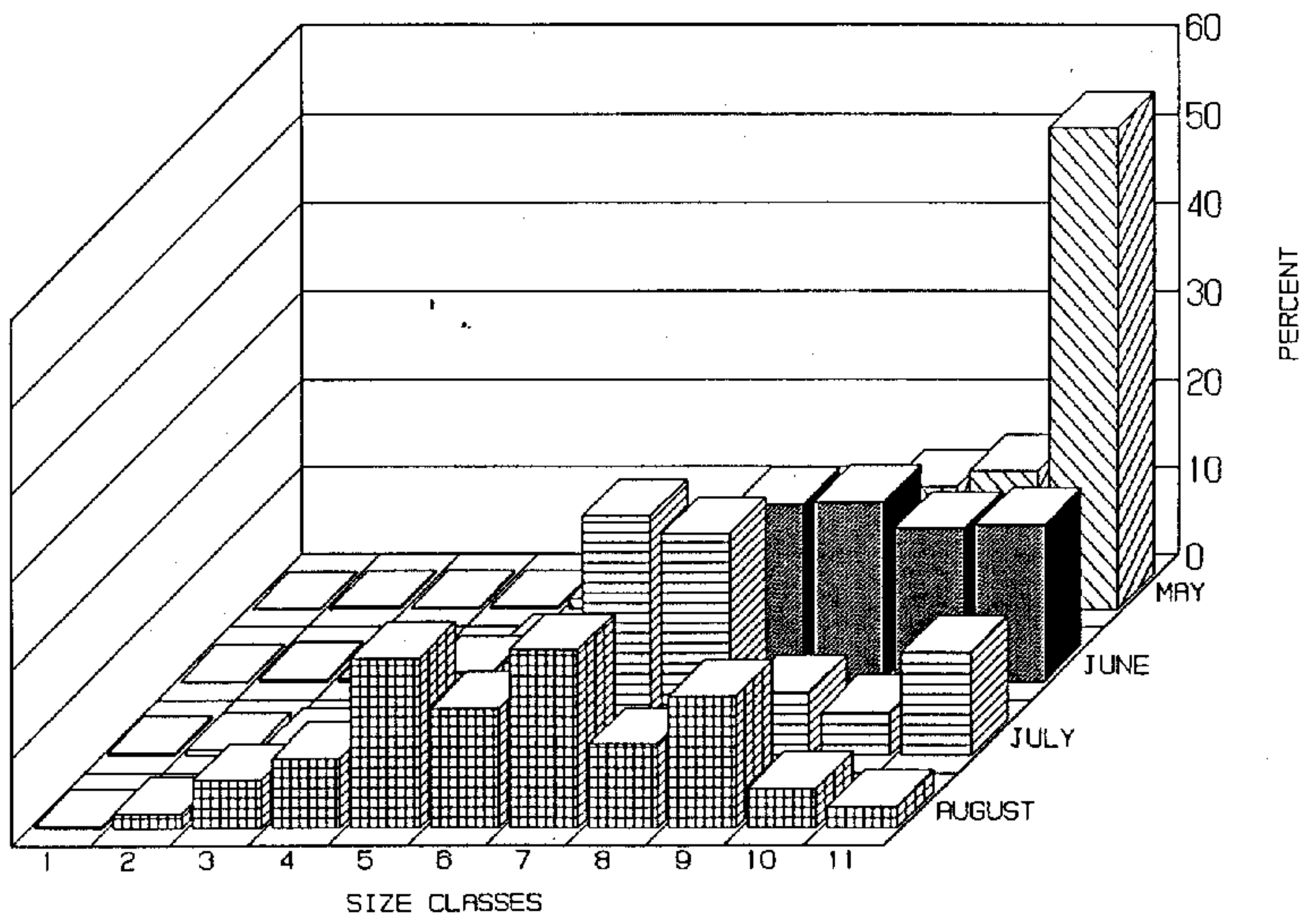


Figure 18. Size distribution of brown shrimp from offshore Louisiana during the May-August 1989 period.

# TEXAS 1989

## OFFSHORE FISHERY

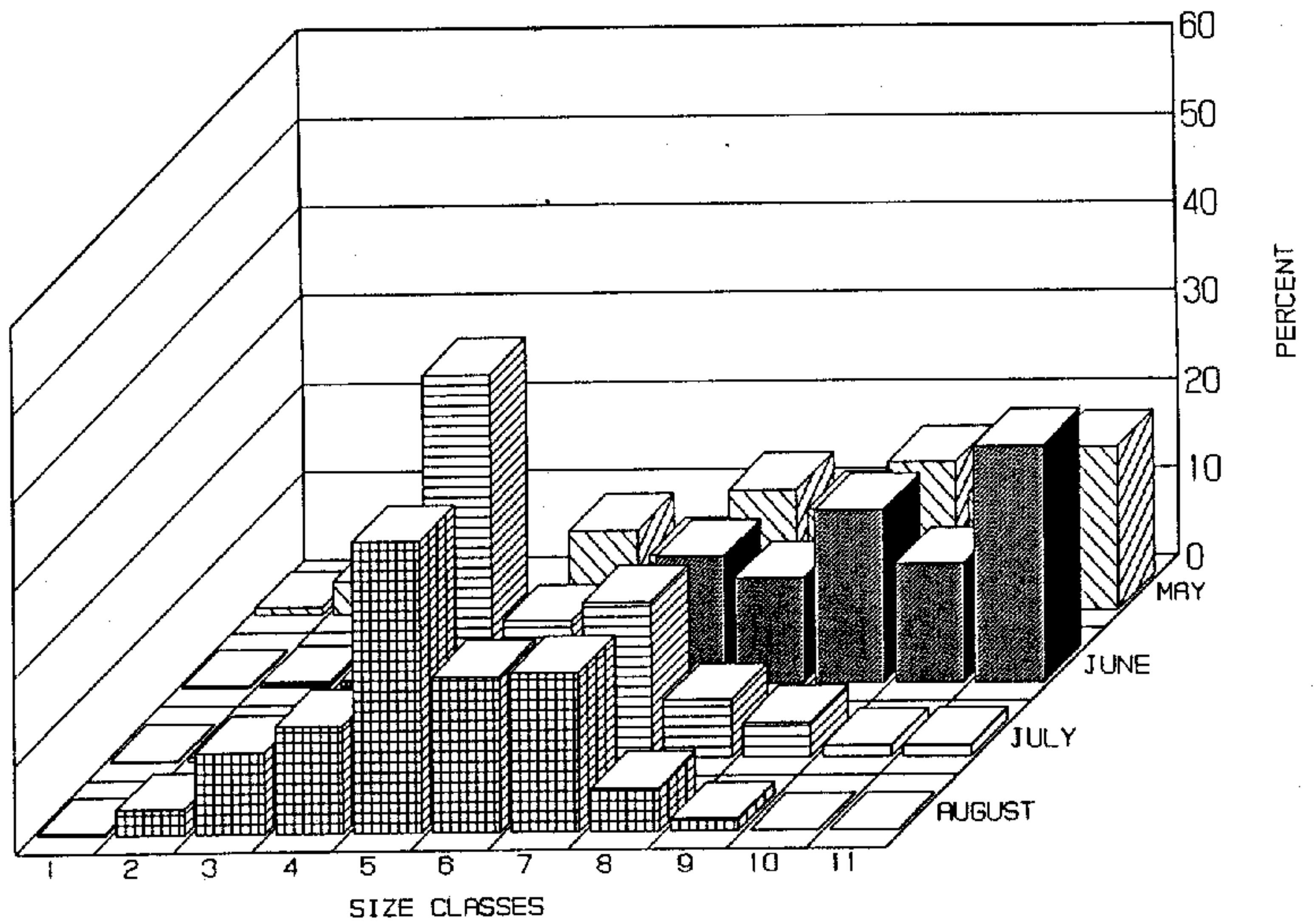


Figure 19. Size distribution of brown shrimp from offshore Texas during the May-August 1989 period.

## JULY CPUE RATIO (TEXAS : OTHER)

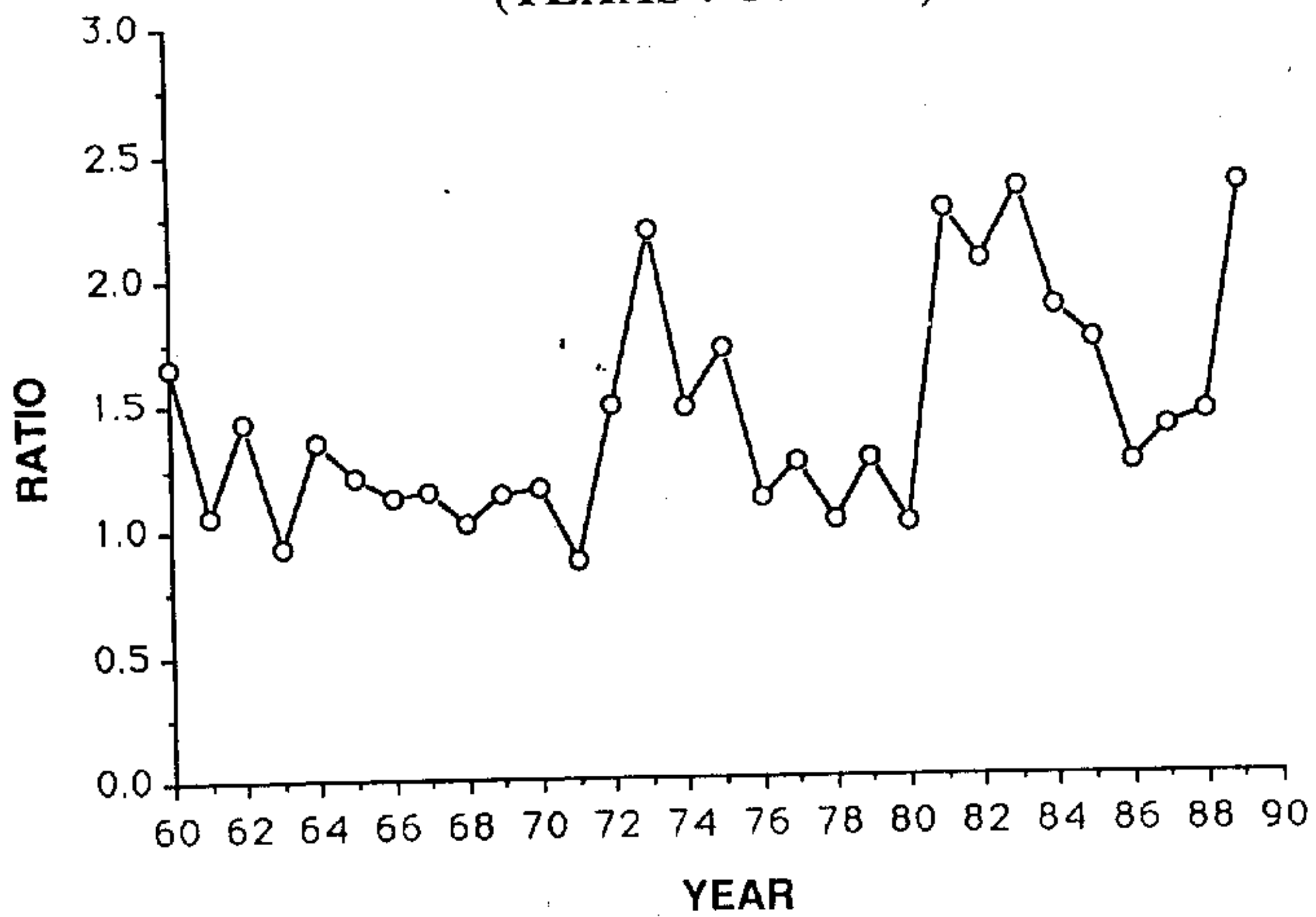


Figure 20. Analysis of July CPUE in the Gulf of Mexico. Ratio is Texas verses elsewhere in the Gulf.



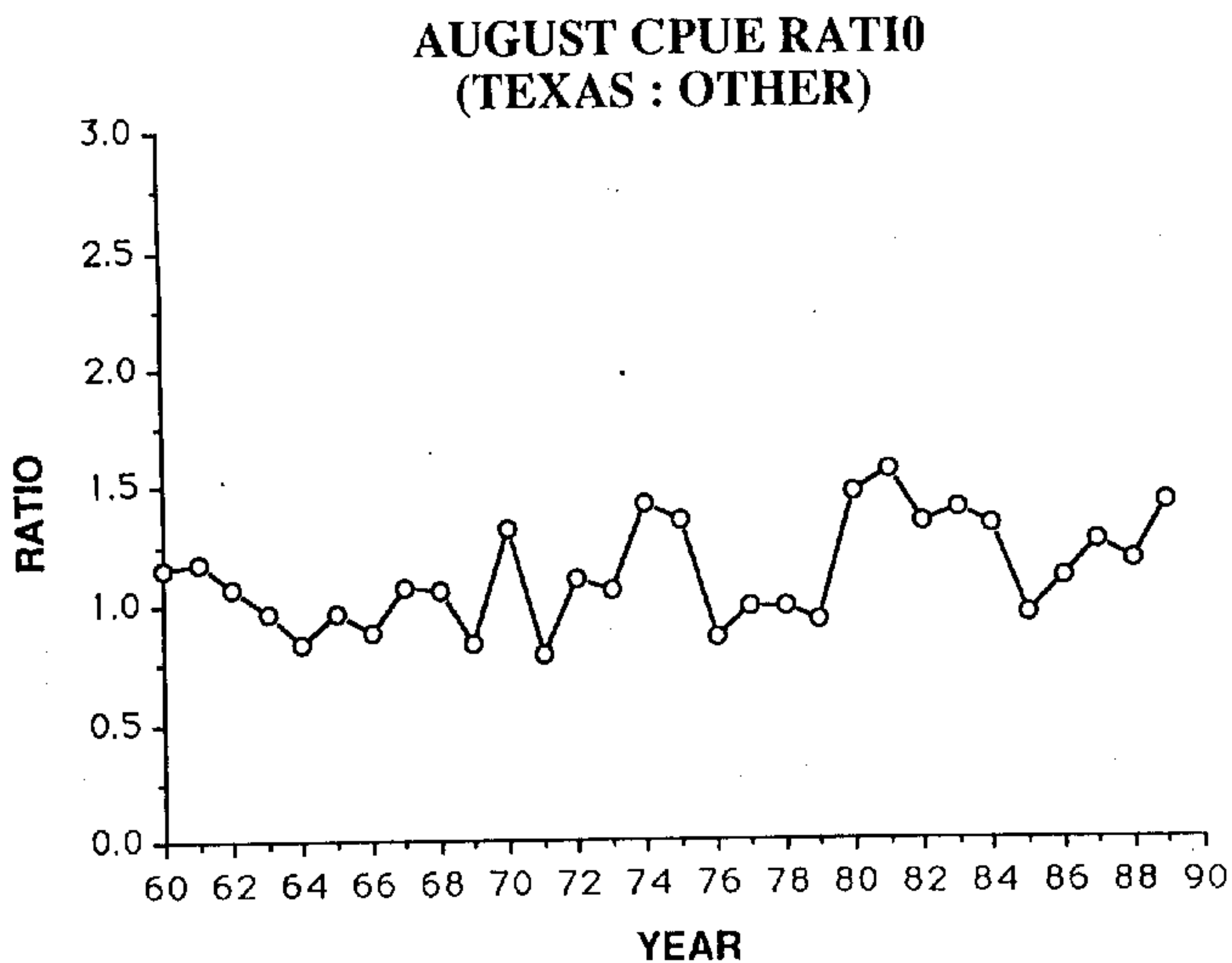


Figure 21. Analysis of August CPUE in the Gulf of Mexico. Ratio is Texas verses elsewhere in the Gulf.

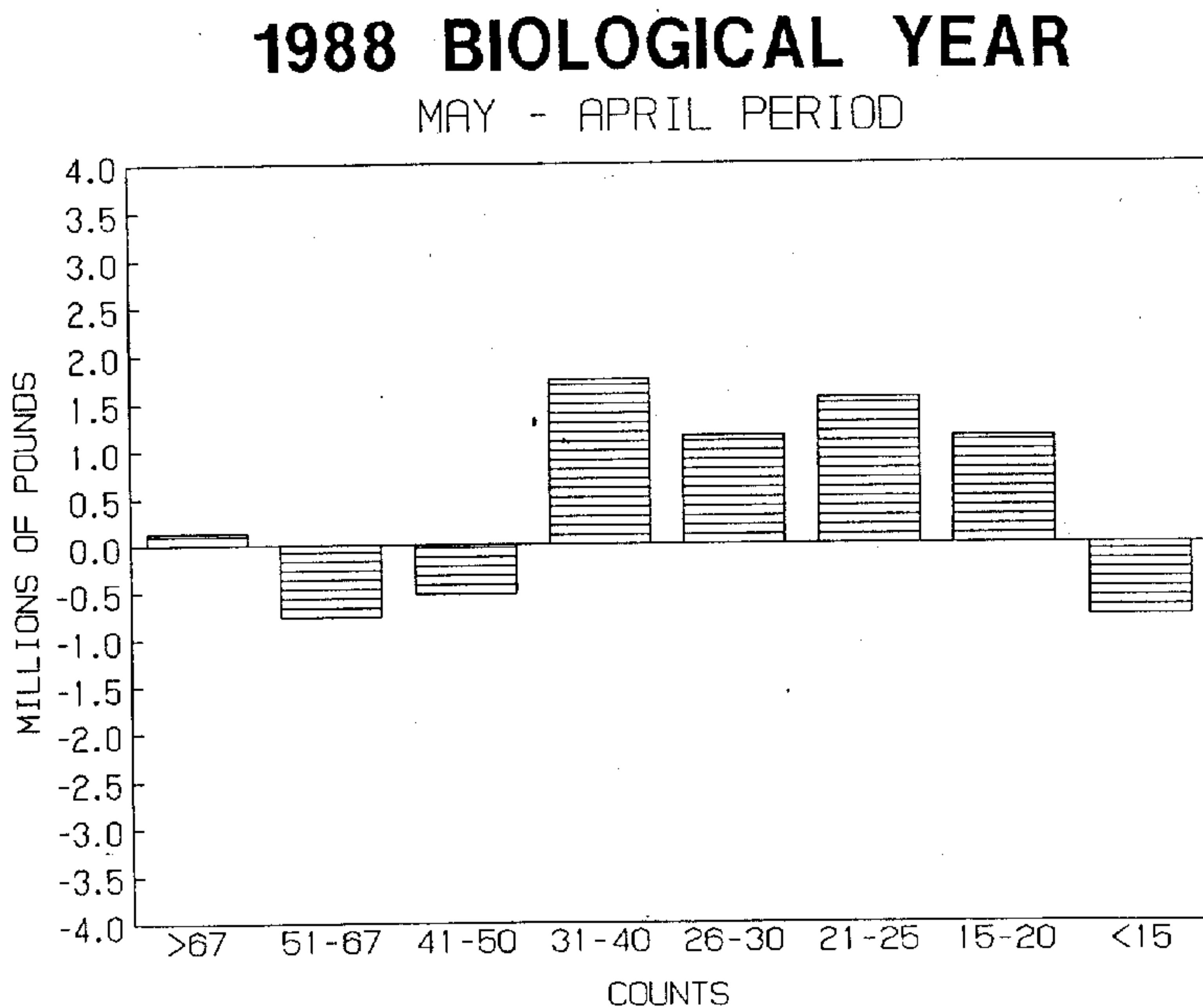


Figure 22. Estimated change in catch for various size groups with a 200 mile nautical mile closure.

# 1989 BIOLOGICAL YEAR

MAY - AUGUST PERIOD

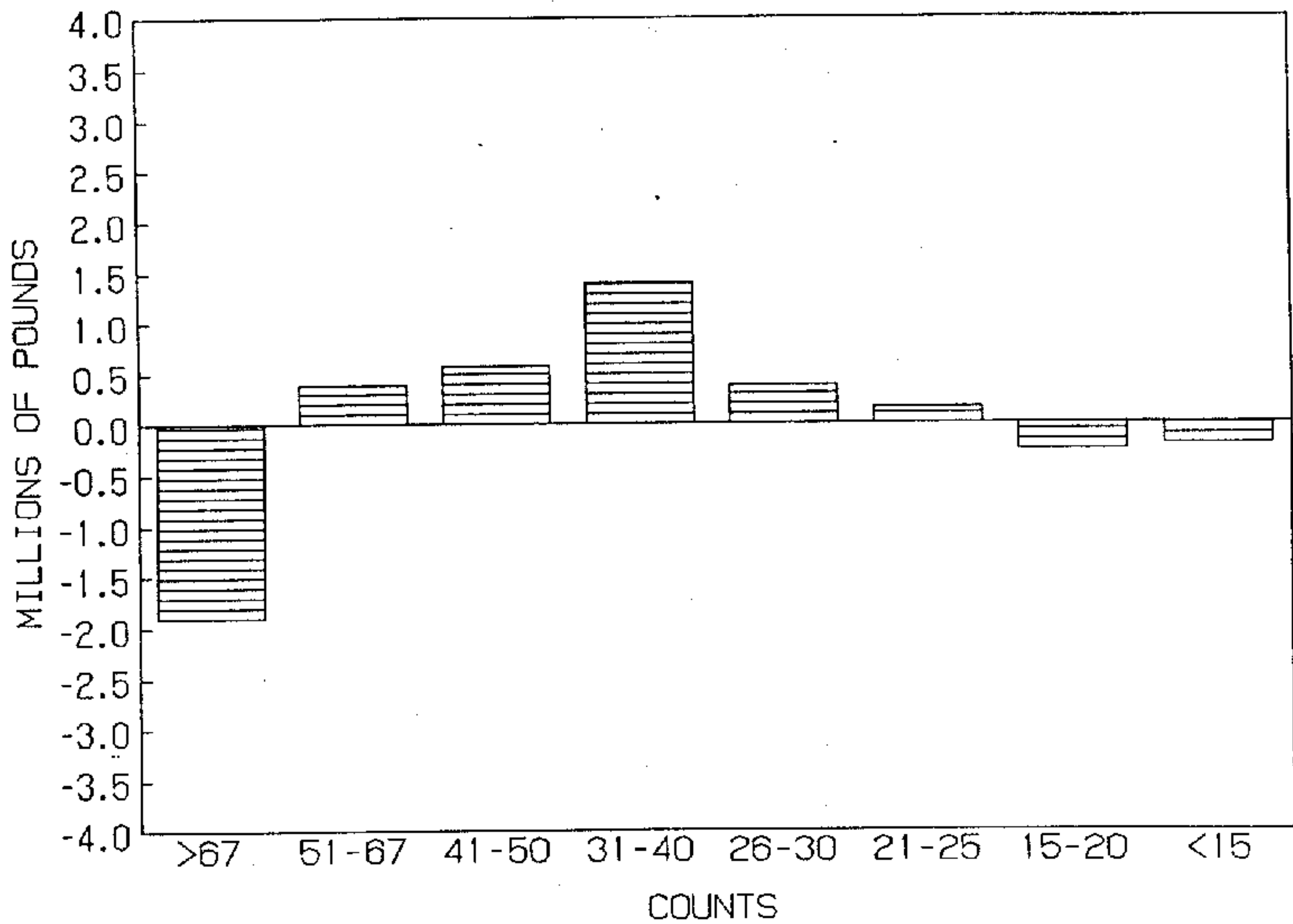


Figure 23. Estimated change in catch for various size groups with a 200 mile nautical mile closure.

# 1989 BIOLOGICAL YEAR

MAY - APRIL PERIOD

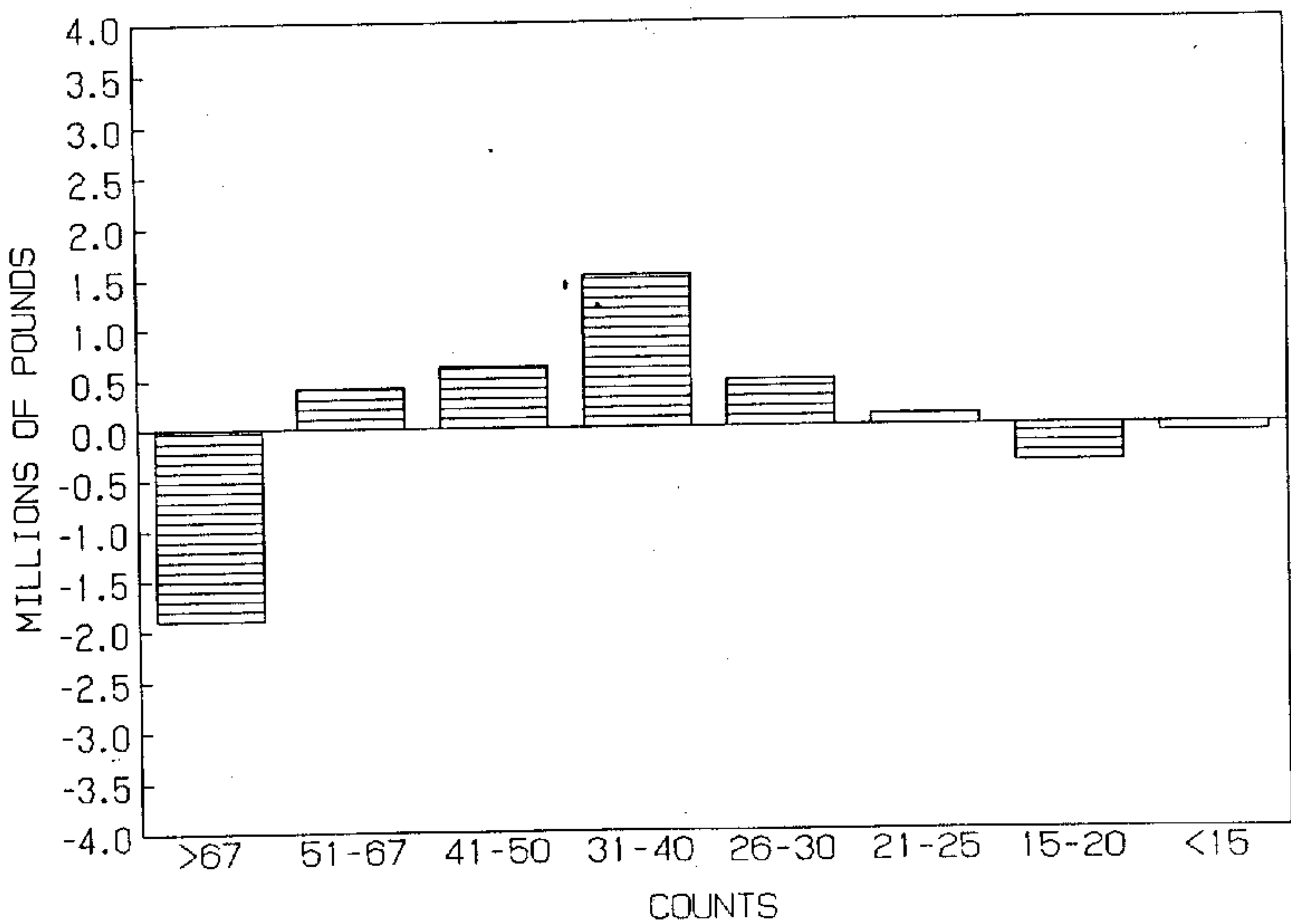


Figure 24. Estimated change in catch for various size groups with a 200 mile nautical mile closure.

## TEXAS EFFORT : GULF EFFORT JUNE

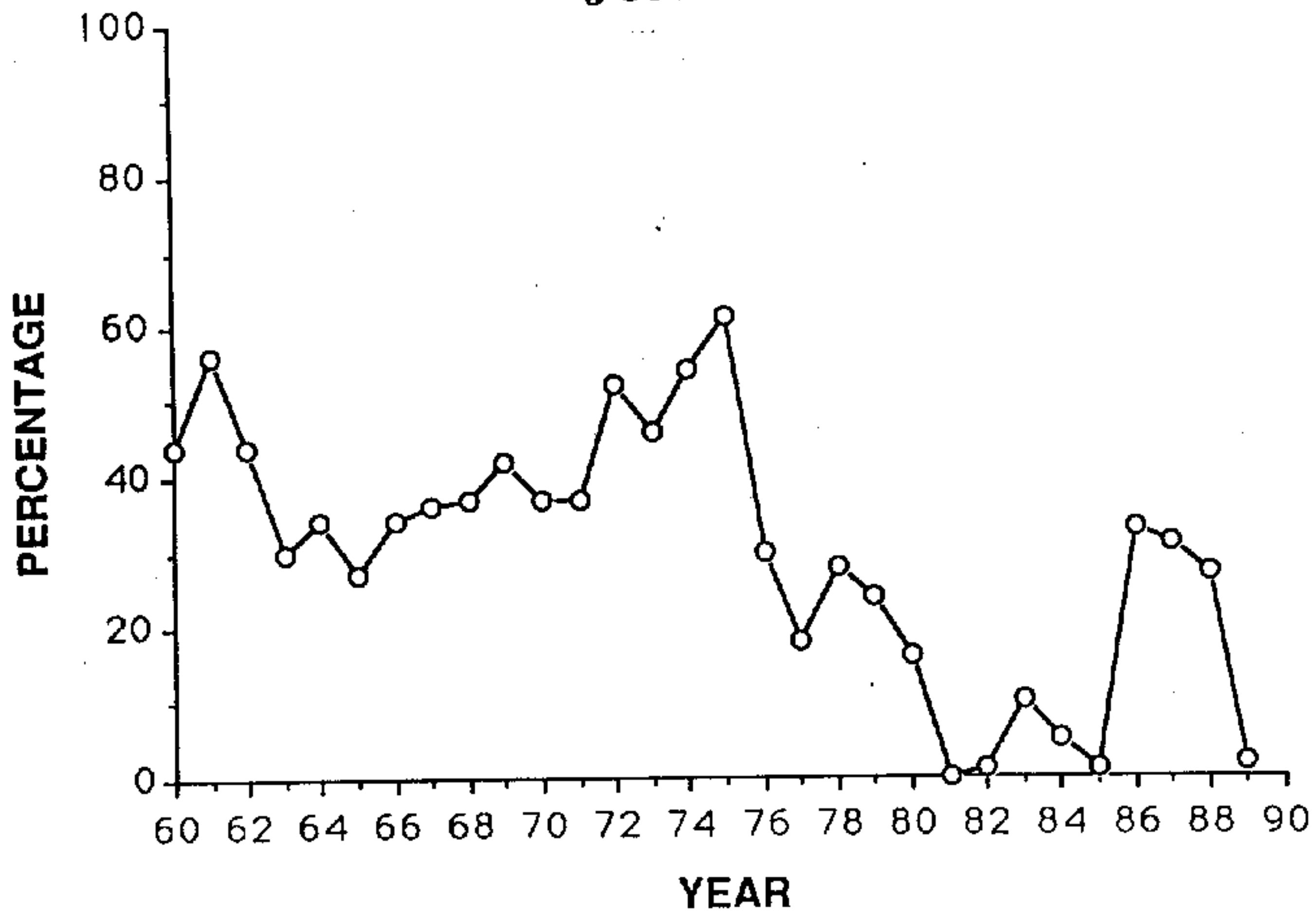


Figure 25. Analysis of June fishing effort. Ratio is Texas verses the total Gulf of Mexico.

## SOURCE OF LANDINGS FOR TEXAS

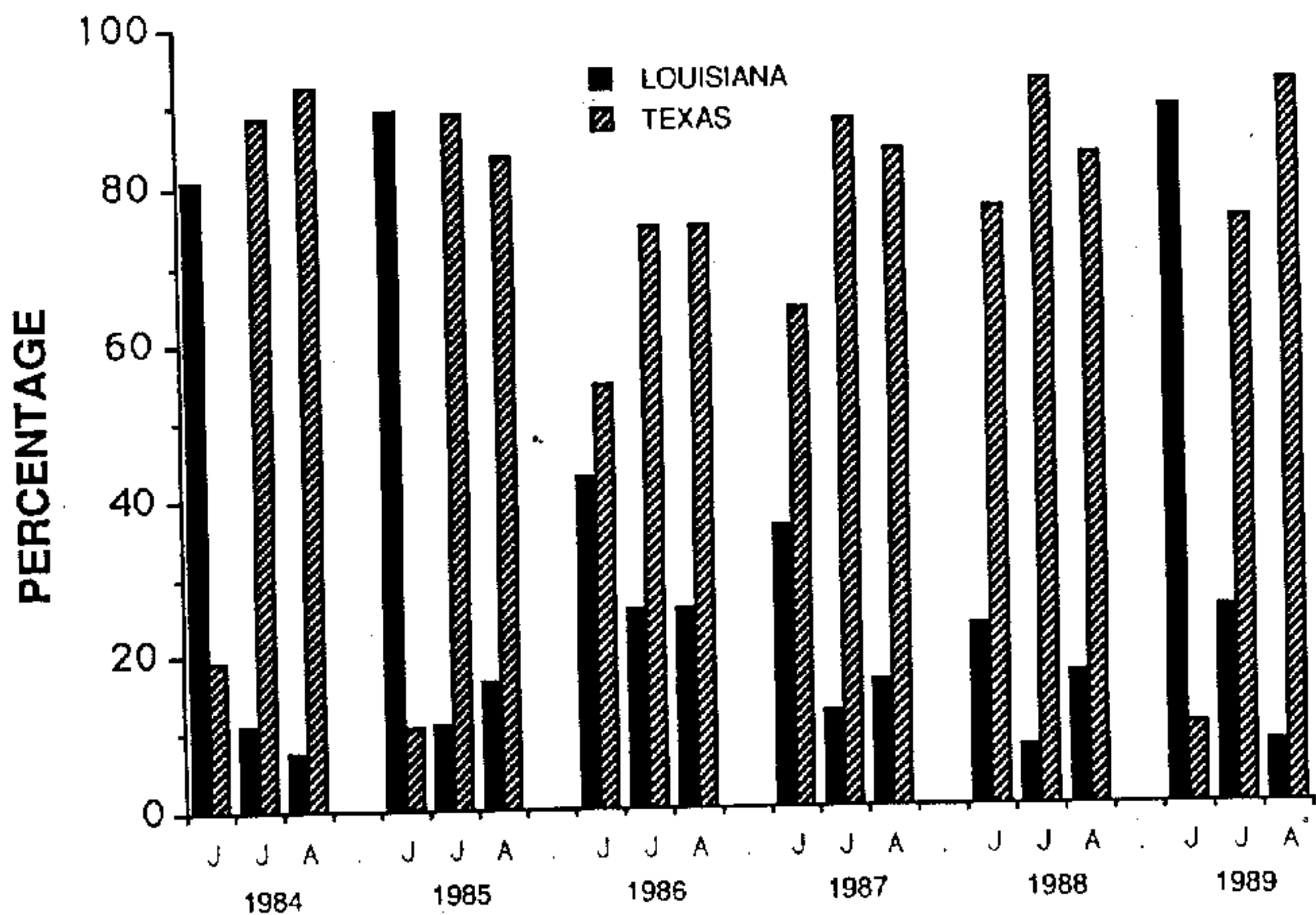


Figure 26. Percentage of landings in Texas taken from either Texas or Louisiana waters.



# WHITE SHRIMP EFFORT FOR JUNE TEXAS NEARSHORE (FM ZONE 1)

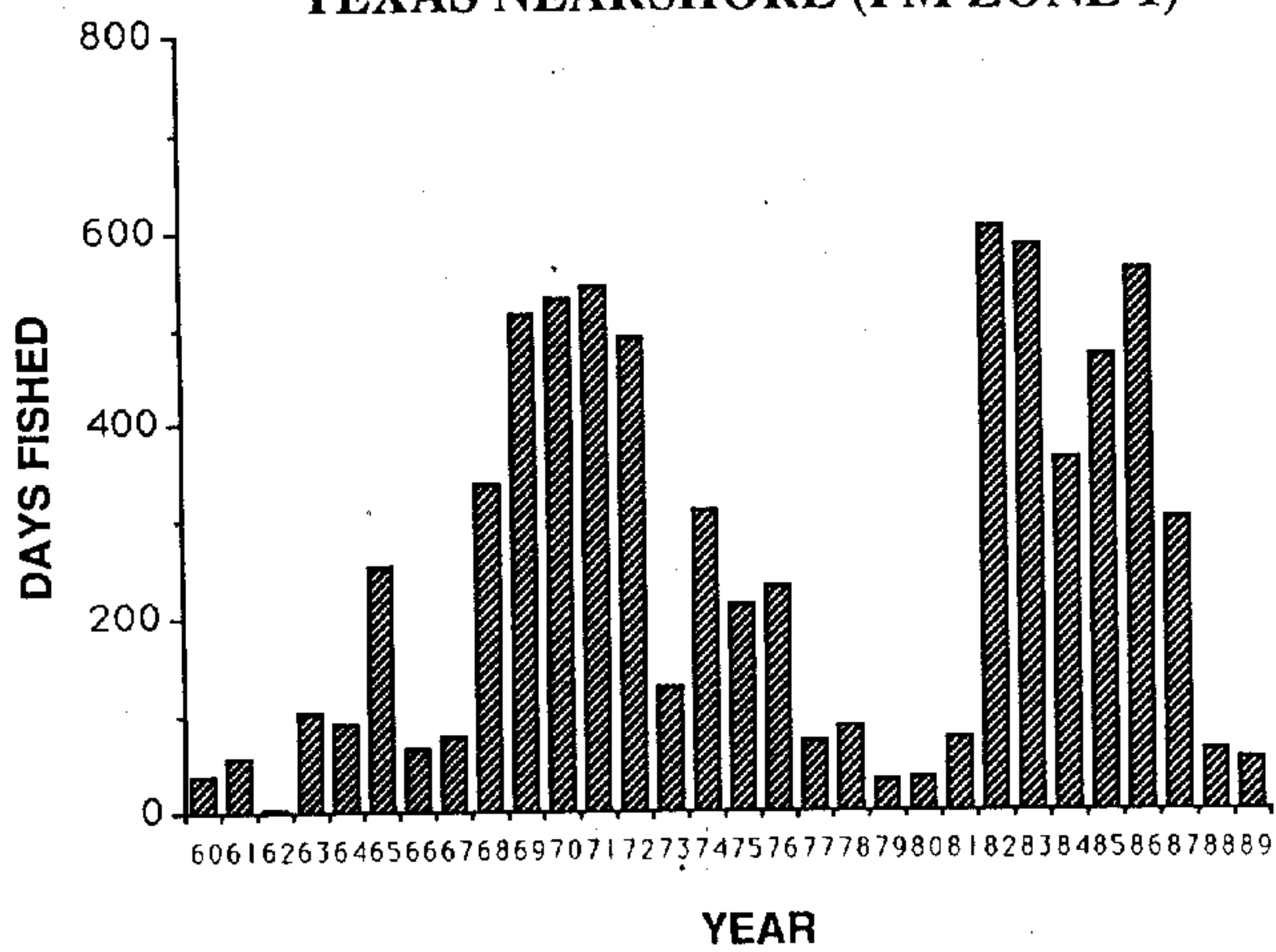


Figure 27. White shrimp directed effort during June in the 0-5 fm depth zone off Texas.

# TOTAL EFFORT INSIDE 15 FM OFF TEXAS

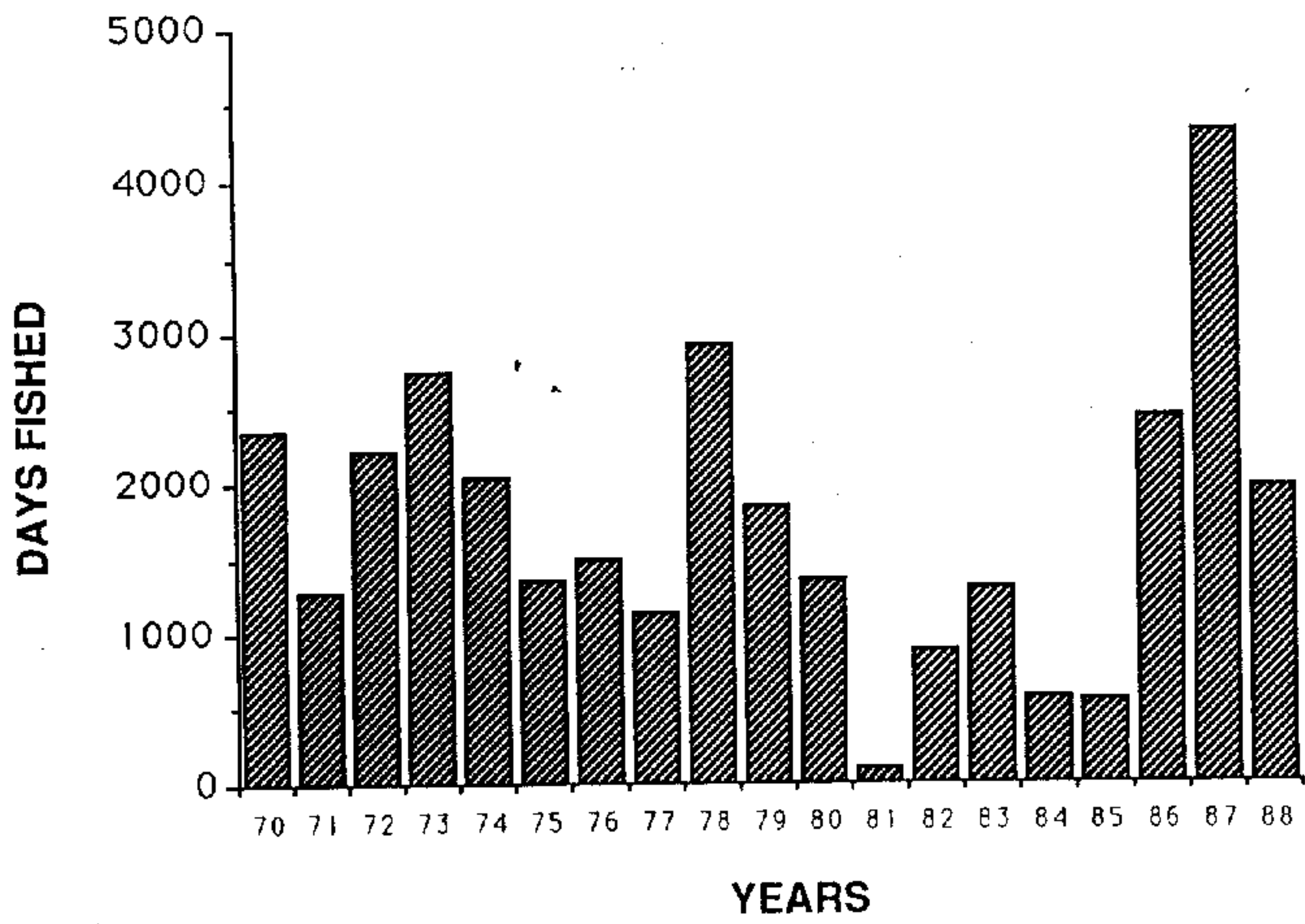


Figure 28. Total shrimping effort during June in the 0-15 fm depth zone off Texas.

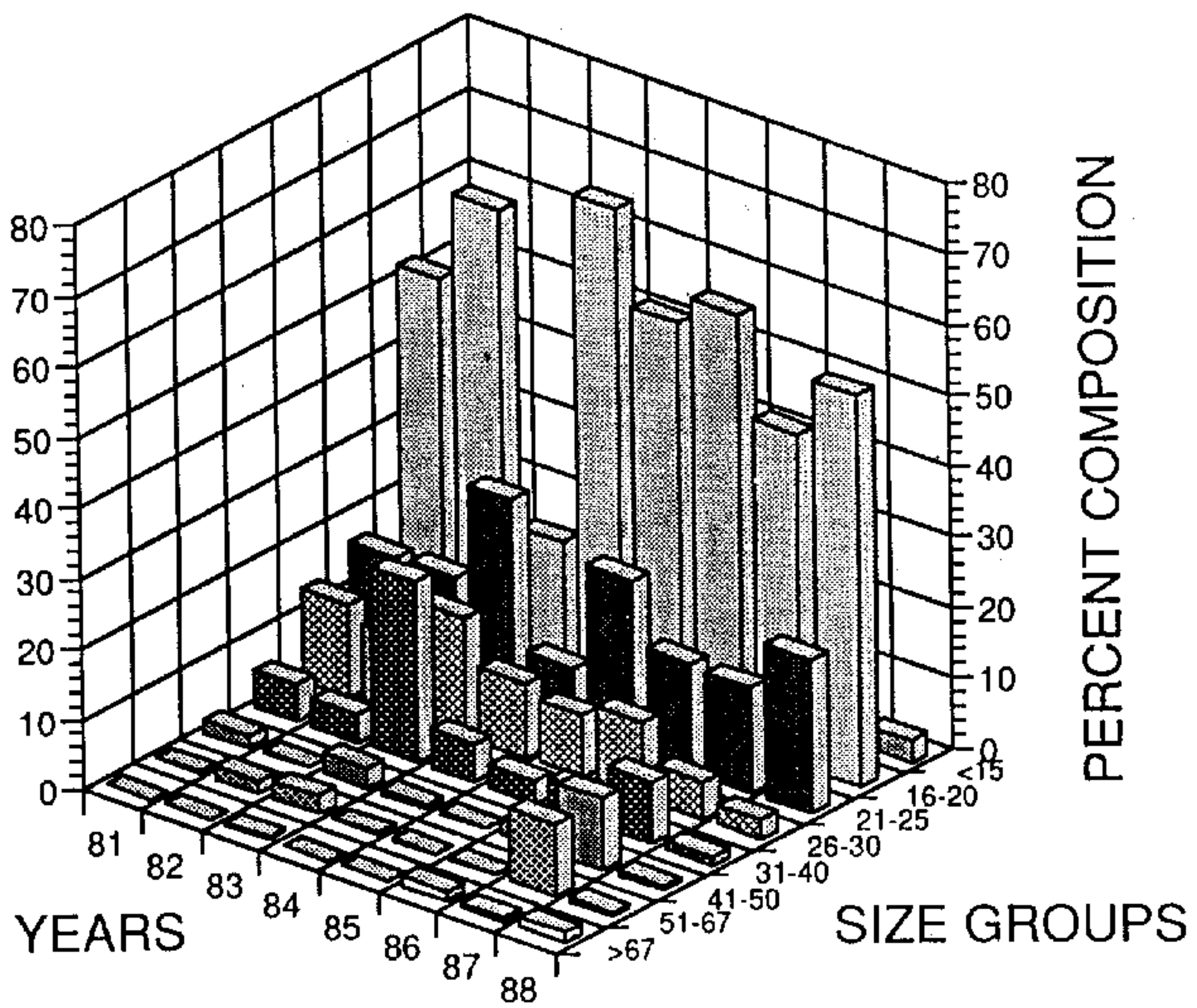


Figure 29. Size composition of white shrimp taken off the Texas coast during the closure period.

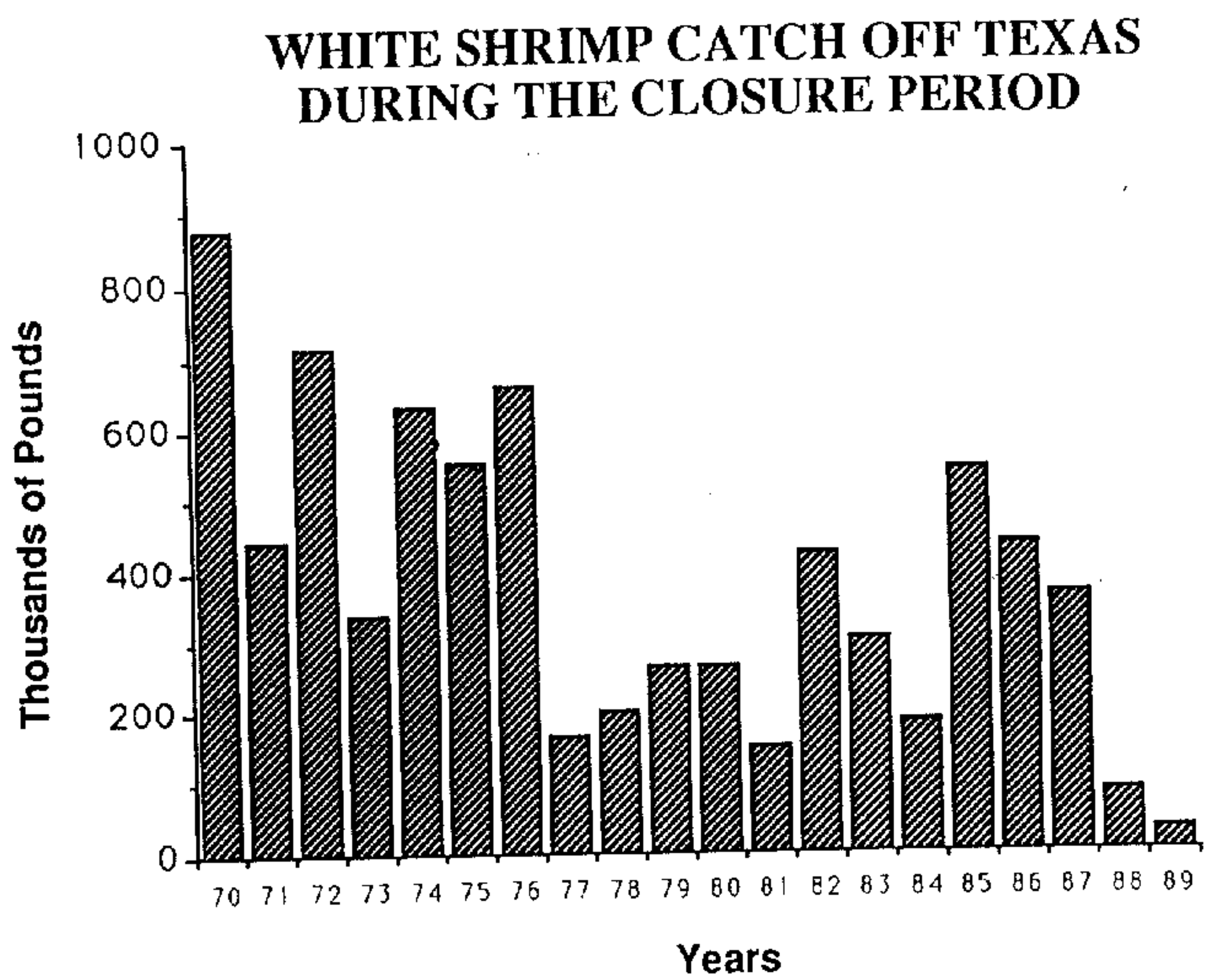


Figure 30. White shrimp catch off the Texas coast during the closure period.

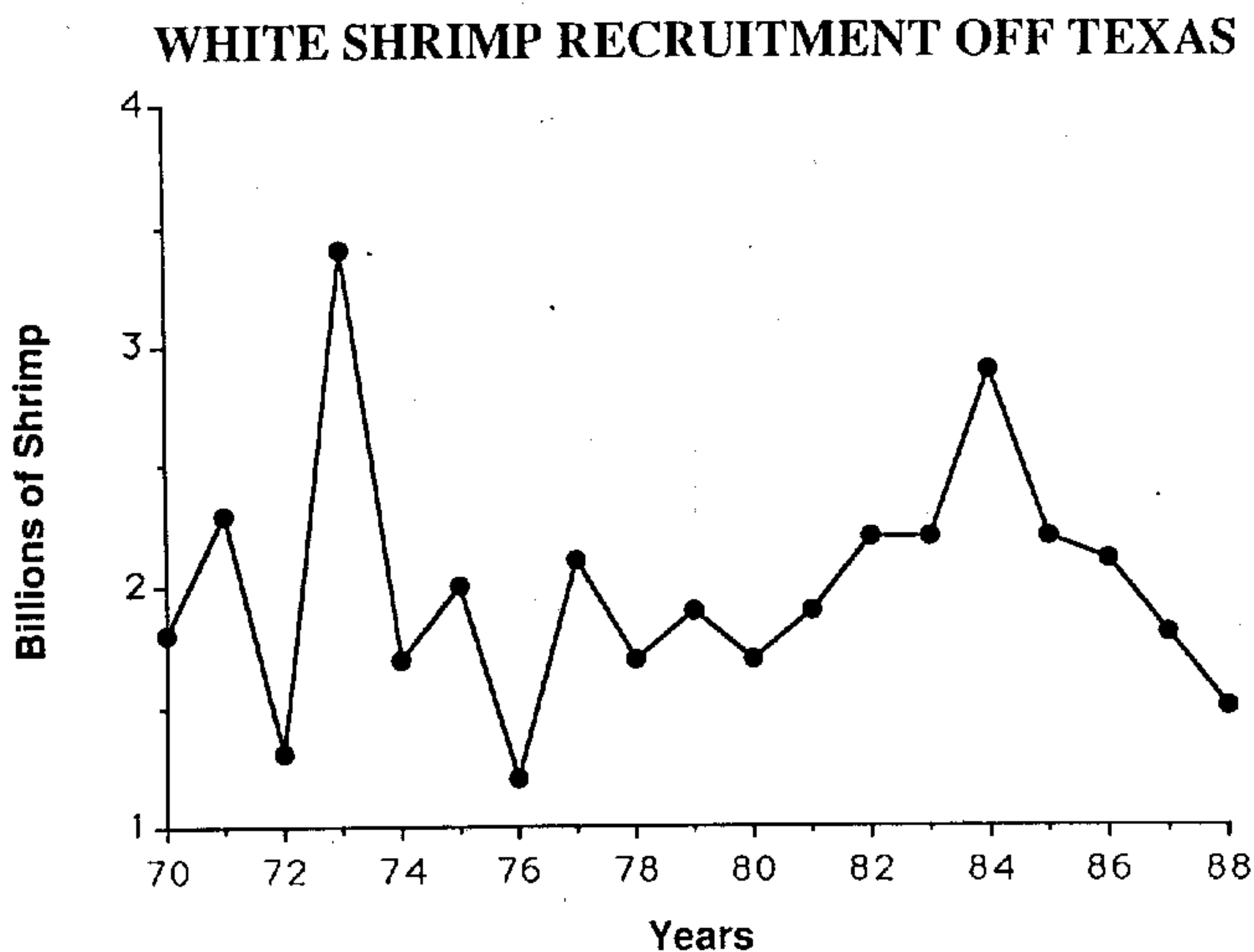


Figure 31. Estimated recruitment of white shrimp off the Texas coast.

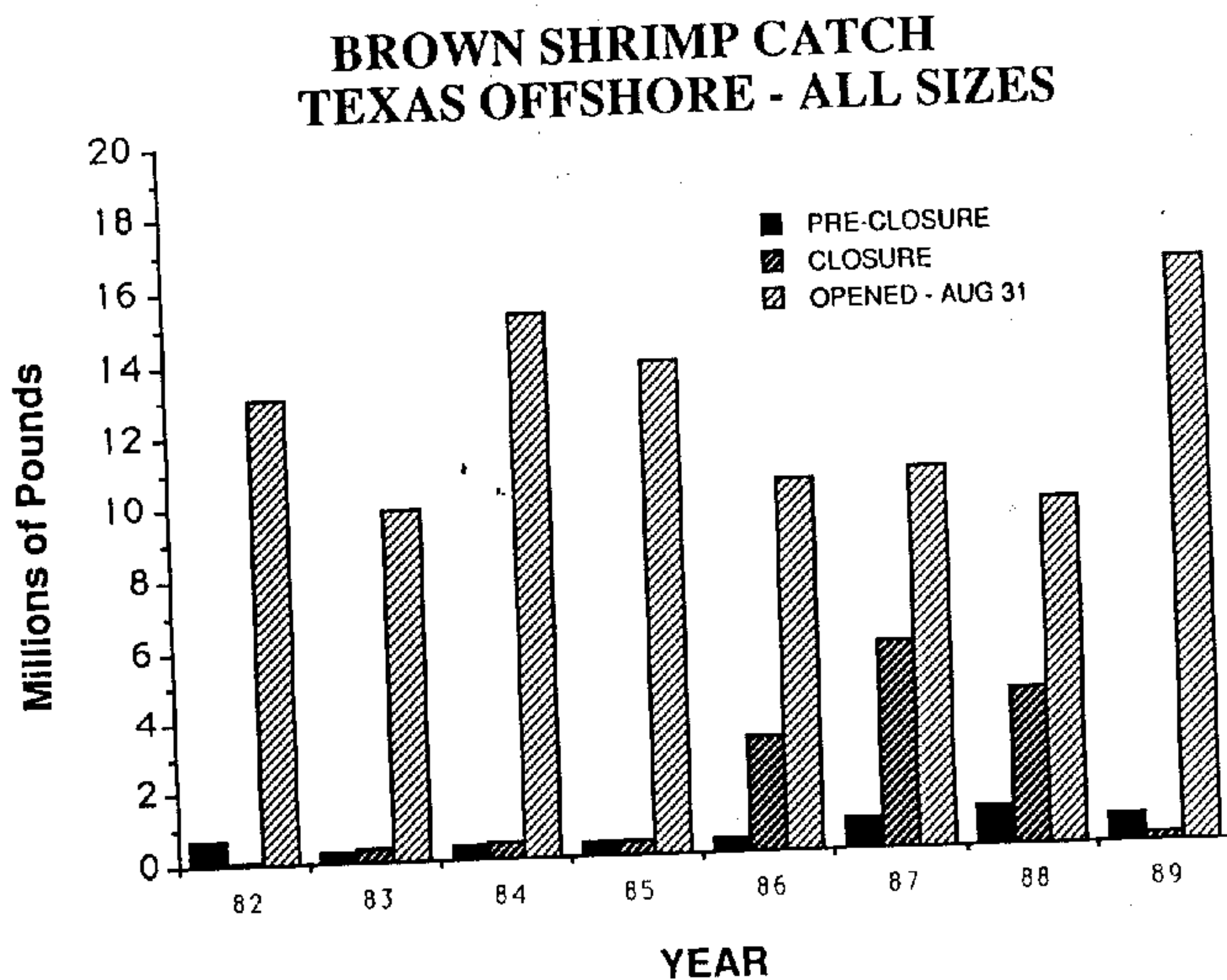


Figure 32. Total landings of brown shrimp from Texas waters during the following periods: 1) pre-closure: May 1 through when offshore waters closed, 2) closure: entire offshore closure period, and 3) Opened: when offshore waters opened through August 31.